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Noticeable levels of diesel smoke and odor both from two-cycle powered city buses and four-cycle powered intercity trucks were investigated. Field studies, development of facilities and procedures, study of vehicle variability, and investigation of two techniques for smoke reduction were included. Result of field studies indicated that the two-cycle powered bus odor and smoke were grossly different from the four-cycle powered truck. Reasonable atmospheric dilution levels from a typical horizontal bus exhaust were found to range from 100:1 to 1000:1, whereas the dilution levels from a vertical exhaust stack equipped truck ranged from 700:1 to 7000:1. Field operation was realistically simulated in a specially designed laboratory odor and smoke measurement facility. The odor measurement method involved simultaneous exposure of a panel of ten persons to a dynamically diluted sample of diesel exhaust. A diesel odor evaluation kit, composed of an overall diesel odor and four different qualities at various intensities, was used as a reference by the panel. Smoke was measured by means of a PHS smokemeter under both constant speed and accelerating type vehicle conditions. Utilizing these measurement methods, chassis dynamometer, panel, and smokemeter procedures were developed for the city bus (five odor and six smoke conditions) and for the intercity tractor (six odor and seven smoke conditions). The trained panel was able to relate the effect of dilution, load, and other operating parameters to the quality/intensity of the dilute sample. These conditions and procedures were then employed to measure the smoke and odor variability from ten similar buses and ten similar trucks. Limited investigations of fumigation and dilution resulted in only a partial or technical success.

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Air pollution control equipment
Dynamometers
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Simulation
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Humidity

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Page 41

The last line of the tabulation in the text: Under Engine Speed-rpm, change 2100-0 to 2100-575.

Page 84

In paragraph (5)--line 4: Change 5.3 to 6.3;
line 5: Change 2.5 to 1.5;
line 6: Change five times as intense to three times as intense.

Appendix C, Page 3

Under Speeds and Loads: Change Engine Speed-mph to Engine Speed-rpm.

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AUG. 27-28
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AN INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE

PART I

Karl J. Springer

for

Automotive Research and Development Section
National Center for Air Pollution Control
Contract No. PH 86-66-93
Public Health Service
Department of Health, Education and Welfare

FINAL REPORT

Reviewed:

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FOREWORD

This project, Part I of a long range investigation of diesel powered vehicle odor and smoke, was initiated by the Automotive Research and Development Section, National Center for Air Pollution Control, United States Public Health Service, Department of Health, Education and Welfare, 3914 Virginia Avenue, Cincinnati, Ohio. The engineering effort upon which this report is based was accomplished by Southwest Research Institute, 8500 Culebra Road, San Antonio, Texas, under Contract U.S. PHS PH-86-66-93 entitled "An Investigation of Diesel Powered Vehicle Odor and Smoke." The author, Mr. Karl J. Springer, was the Project Leader of the research and development work. This program started on February 18, 1966 and was completed March 18, 1967.

The Project Officer cognizant of this program was Mr. Ralph C. Stahman, Chief, Emission Control Research and Development Group, Automotive Research and Development Activity, U. S. Public Health Service, National Center for Air Pollution Control, 3914 Virginia Avenue, Cincinnati, Ohio 45227. The project was identified within Southwest Research Institute as No. 10-1867.

ABSTRACT

This program, Part I of a long range investigation, was concerned with noticeable levels of diesel smoke and odor both from two-cycle powered city buses and four-cycle powered intercity trucks. The program included field studies, development of facilities and procedures, study of vehicle variability, and investigation of two techniques for smoke reduction. The field studies were conducted to determine: (1) operating conditions that produce significant levels of odor and smoke, and (2) the level of atmospheric exhaust dilution that a motorist or pedestrian might experience behind a bus or truck. Results of the field studies indicated that the two-cycle powered bus odor and smoke were grossly different from the four-cycle powered truck. Reasonable atmospheric dilution levels from a typical horizontal bus exhaust were found to range from 100:1 to 1000:1, whereas the dilution levels from a vertical exhaust stack equipped truck ranged from 700:1 to 7000:1. These results permitted realistic simulation of field operation in a specially designed laboratory odor and smoke measurement facility. Newly developed Public Health Service smoke and odor measurement methods were employed in this facility. The odor measurement method involved simultaneous exposure of a panel of ten persons to a dynamically diluted sample of diesel exhaust. A diesel odor evaluation kit, composed of an overall diesel odor and four different qualities at various intensities, was used as a reference by the panel. Smoke was measured by means of a PHS smokemeter under both constant speed and accelerating type vehicle conditions. Utilizing these measurement methods, chassis dynamometer, panel and smokemeter procedures were developed for the city bus (five odor and six smoke conditions) and for the intercity tractor (six odor and seven smoke conditions). The trained panel was able to relate the effect of dilution, load, and other operating parameters to the quality/intensity of the dilute sample. These conditions and procedures were then employed to measure the smoke and odor variability from ten similar buses and ten similar trucks. The variability study confirmed the gross differences in odor and smoke consistently found throughout the program between the two-cycle and four-cyle powered vehicles. The data also indicated the range of variability to be expected. Limited investigations of fumigation and dilution (two proposed methods for reducing smoke) resulted in only a partial or technical success. A series of recommendations is offered including an expansion of the atmospheric exhaust dilution studies, continued study of chemical and instrumental methods for correlation with the odor panel responses, and determination of public objectionability to various levels of diesel odor and smoke.

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I. INTRODUCTION

Emissions from diesel powered vehicles, within the past year, have been the subject of increased industrial and government sponsored study. Under the 1965 Amendments to the Clean Air Act of 1963, the Public Health Service, National Center for Air Pollution Control, Automotive Research and Development Section, developed a broad program to investigate diesel emissions. Scott Research Laboratories are conducting studies of diesel exhaust chemistry, odor analysis, and odor chemistry under joint Public Health Service-Coordinating Research Council sponsorship. Dr. Amos Turk, odor consultant, Dr. Dean Foster, research psychologist, and Dr. Ralph Bradley, statistical consultant, were retained by PHS to develop odor evaluation procedures involving a human panel in conjunction with the Scott program. The Petroleum Research Center, U. S. Bureau of Mines, is under contract to PHS to develop emissions maps for diesel engines under various operating conditions and to evaluate various fuels and fuel additives. These studies will include odor and smoke measurements as well as detailed analyses of the exhaust for various hydrocarbons, NO_x, etc.

The third major contracted study is concerned with odor and smoke emissions from diesel powered trucks and buses. Part I of this investigation reported herein was recently completed by Southwest Research Institute. The nature of the Southwest Research Institute program was such that the work required special test facilities and procedures and determination of base line data.

A. Objective

The objective of the Southwest Research Institute program was to provide assistance to the Public Health Service in the development of engineering data regarding diesel emissions. Specifically, this program was intended to determine those vehicle operating conditions that produce significant levels of odor and smoke and develop procedures and methods to permit quantitative measurement of odor and smoke in the laboratory for evaluative purposes. This project was limited to investigation of two widely used diesel engine-vehicle combinations. For purposes of procedural development, the two-cycle GM-6-V-71 powered municipal bus and the four-cycle Cummins NH 220 powered, tandem axle, intercity truck-tractor were used. In addition to base line smoke and odor data, determination of vehicle variability involving ten similar buses and ten similar trucks was made. Limited investigation and evaluation of fumigation and exhaust dilution techniques were also included in the scope of the program.

B. Approach

To provide realistic guidelines, field studies were conducted to determine operating conditions that produce significant levels of odor and smoke. At the same time, trace gas surveys were conducted to determine the natural dilution which occurs to diesel powered vehicle exhaust. The experience and data resulting from these field studies were then translated to the laboratory for development of chassis dynamometer road load and inertia simulation procedures. In addition, a unique odor facility was utilized to develop measurement procedures, using a dynamic dilution facility and a ten-person odor panel

To assure realistic data, buses and trucks from normal service fleets were utilized. The General Motors (GM) Truck and Coach Division Model TDH-4519 Municipal buses were provided from the San Antonio Transit System, and truck-tractor units were supplied by the Ryder Truck Leasing Company, ABC Truck Rental (National Leasing Co.), and the Howell Refining Company. In addition, an experienced bus and truck operator was employed to make certain vehicle operation was typical and normal.

II. FIELD STUDIES

The field studies consisted of (1) surveys to determine what operating conditions produce significant odor and smoke levels and (2) tests to determine the natural atmospheric dilution of vehicle exhaust. The results from both the operating condition survey and the exhaust atmospheric dilution study were essential for conduct of the remainder of the program.

A. Initial Road Odor and Smoke Measurements

The objective was to determine in the field those vehicle operating conditions which produced significant levels of odor and smoke. Measurement was made by a small panel of four men riding in an open sedan behind a diesel powered bus or truck. The small panel consisted of an engineering student (senior year), senior technician, clerk, and senior research engineer.

1. Small Panel Procedure

The panel was trained by the Project Leader, Karl Springer, and the odor panel instructor, Orville Davis (both members of the panel), in the rating procedure adopted. The rating procedure, fairly standard for this type of jury evaluation, consisted of rating the odor and smoke intensity on the following scale:

0 - None

1 - Trace

2 - Slight

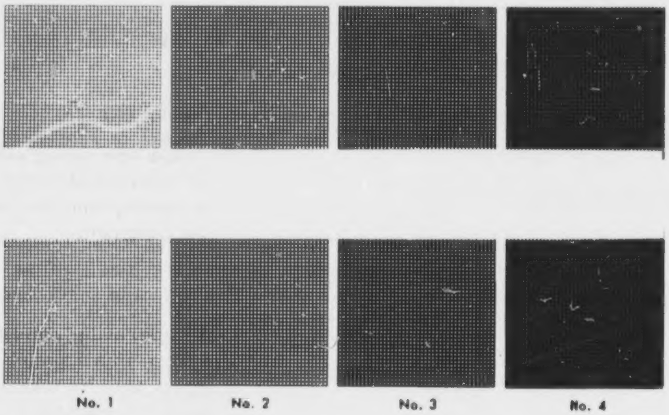
3 - Moderate

4 - Heavy/Strong

A similar scale for the evaluation of the intensity of the smoke was employed during the bus study. This procedure was applied to the bus horizontal exhaust with some difficulty because of the pavement background, etc.

In addition to the bus driver, a sixth member of the team was positioned in the rear of the bus to synchronize the operating mode recorder (engine speed and vehicle speed). The bus was operated under a wide variety of different conditions including level road cruise at various constant speeds; acceleration on a level, uphill, and downhill; deceleration on a level, uphill, and downhill; open rack cruise at various constant speeds; etc. The bus was then operated under simple combinations of the above that would be typical of normal bus operation. Panel evaluations were then made of the emitted odor and smoke at various distances behind the bus and in several directions. The panel seating arrangement was rotated to minimize the effect of panelist location within the trailing car. This car was a 1963 Pontiac Catalina with all windows down and vents open.

The procedure for measurement of truck exhaust odor was the same as that used in the city bus study. For the purposes of evaluating the smoke emissions from the vertical truck exhaust stack, however, the small panel was trained to use a MicroRingelmann smoke density chart. Figure 1 is a reproduction of the front and back sides of the chart which is similar in use to the California Ringelmann. The smoke plume was viewed through the rectangular slit in the center of the card and compared to the various Ringelmann densities. The reason for using a smoke chart was to permit each jurist to rate the exhaust plume by a common system and thus obtain improved smoke data. The data obtained, using this system, are not to be construed as absolute values of smoke intensity, however, but are intended to indicate trends and those operating conditions which produce significant smoke.



Power's MICRORINGELMANN

These grids are a direct facsimile reduction of the standard Ringelmann Chart as issued by the United States Bureau of Mines. Copyright 1954 by McGraw-Hill Publishing Company, Inc. (Publisher of Power) 330 W 42nd St, New York 36, N Y

Price: 35¢ each, discount on quantities

Front Side

Power's **MicroRingelmann** is an accurate photographic reduction of the standard Ringelmann Smoke Chart as published by the United States Bureau of Mines.
For best results, use this card according to the following instructions:

1. Hold chart at arm's length and view smoke through slot provided.
2. Be sure that light shining on chart is the same light that is shining on smoke being examined; for best results, sun should be behind observer.
3. Match smoke as closely as possible with corresponding grid on chart.
4. Enter density of smoke (designated by numbers under each grid) on record sheet; also enter time of each observation.
5. Repeat observations at regular intervals of $\frac{1}{4}$ or $\frac{1}{2}$ minute.
6. To compute smoke density, use the formula
   $$\frac{\text{Equivalent units of No. 1 smoke} \times 0.20}{\text{number of observations}} = \text{percentage smoke density}$$
7. Note and record distance to stack, direction of stack, shape and diameter of stack and speed and direction of wind.

Back Side

FIGURE 1. MICRORINGELMANN SMOKE CHARTS USED DURING FIELD STUDY OF TRUCK SMOKE

2. Results

The results of the initial small panel road odor and smoke survey are discussed in the following paragraphs for (1) the municipal bus and (2) the intercity truck studied.

a. Municipal Bus

The results and data obtained with the small panel for a General Motors Truck and Coach Division Model 4519 municipal bus, powered by an E series, two-valve, Detroit Diesel 6V-71, two-cycle engine, are presented in Appendix A*. The average panel ratings for both odor and smoke are shown in Table 1 of this appendix for a variety of operating conditions. In addition to the operating variables of vehicle speed, engine operation, uphill, downhill, and level street and roads, the panel was positioned at various distances behind the bus. Tables 2 and 3 summarize the Table 1 data by listing all those observed conditions which resulted in an average panel rating of 3 or greater. Table 2 lists the significant odor conditions, and Table 3 contains the significant smoke producing conditions. The Table 2 data indicate some important odor trends described below:

(1) Constant speed cruise less than 35 mph on level ground did not appear important.

(2) Constant speed at maximum power, either uphill or at maximum speed (45 mph), appeared important.

(3) Idle operation, with a stationary vehicle, was not important alone.

(4) In general, the distance the panel was located from the bus did not have a great effect on the panel response during moving conditions. Apparently, the odorous materials had a lasting effect under light, less than 6 mph, wind conditions.

(5) Acceleration (full rack), after prolonged idle of 1/2 to 1 minute, seemed significant.

(6) Closed rack deceleration from a medium to high speed (30 to 40 mph), high power condition appeared significant.

(7) Closed rack deceleration from low to moderate (20 to 30 mph), high power (near open or open rack) conditions downhill may have been as important as Item (6).

Although quality and objectionability were not intended to be a part of this evaluation, it should be reported that the quality of the deceleration odor detected shortly after start of the deceleration of condition (6) above was different from the typical two-cycle diesel odor. Several members of the panel reported that the quality was not only different but less pleasing than the typical diesel odor.

According to Table 3, smoke is dependent on engine power output. Practically any open rack acceleration or maximum power cruise, especially in the drive range of the transmission, say uphill or open rack cruise (45-mph level without the air-conditioner operating), resulted in a noticeable level of smoke. It should be noted that the panelist was exposed to the heaviest level of smoke produced by the bus studied, and a rating of 4 was then assigned. All other levels were then considered somewhere between 0 and 4. The remainder of the initial field studies was concentrated on the determination of significant odor producing conditions since smoke producing conditions were fairly well defined.

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*All of the tables called out in this section, "II. A. Initial Road Odor and Smoke Measurements," are presented in Appendix A.

Table 4 contains the odor responses of the small panel while standing across the street from the bus. Note the 7-mph crosswind which carried the exhaust toward and directly into the panel. It seemed that this was the only way that near significant idle-acceleration ratings could be obtained. Similar evaluations on a residential bus stop under calm wind conditions resulted in substantially lower odor levels. These experiments were conducted with the panel standing on the curb next to the bus's front door, rear door and back bumper. The horizontal exhaust pipe tended to throw the exhaust into the center and left lane of the street.

Table 5 lists the results of additional constant speed odor evaluations and tends to confirm the lack of significant odor levels under constant speed cruise conditions (less than 35 mph) on a level road at reasonable distances behind the bus. Additional idle-acceleration-constant 40-mph speed-deceleration conditions were evaluated for odor intensity; the results are tabulated in Table 6. From these data, it is apparent that the idle, by itself, was not found to produce significant odor. The full rack acceleration after prolonged (1 minute) idle was significant, while the constant speed cruise on level ground was not so important. The interesting and unexpected increase in odor quality and intensity found during deceleration, which was described previously, was again experienced. The odor was not only more intense but definitely had a different, possibly less pleasant, character. Neglecting the effect of run direction, wind, etc., the idle-acceleration to 40 mph-40-mph cruise-deceleration data of Table 6 was summarized by the distance the panel was located from the rear of the bus. This summary, Table 7, indicates that the idle and constant speed odor intensity decreased with increased distance. The average odor intensity experienced during acceleration was maximum about 30 feet behind the bus rather than at 20 or 10 feet. It was felt that this was due to the horizontal exhaust pipe throwing the exhaust around and to left side of a car following very cosely behind the bus.

Additional experiments similar to those reported in Table 6 were conducted at lower and higher speeds. The results of these idle-acceleration-constant speed-deceleration runs are listed in Table 8. Essentially the same comments as made about the Table 7 summary, regarding the odor intensity levels at idle and constant speed cruise, can be made about the experimental data of Table 8. The accelerations, all made at open rack with or without air conditioning and evaluated at 20 or 30 feet, showed fairly consistent, significant, odor levels. The deceleration odor was not found to be particularly important except at closed rack decelerations above 35 mph (without air conditioning) or 30 mph (with air conditioning). The effect of the air-conditioner was one of demanding additional horsepower and making the engine work as if the bus were at, say, 35 instead of 30 mph. The air-conditioner also had the effect of causing the engine to slow down quicker during closed rack deceleration.

The initial panel data so far have been concerned with the odor and smoke levels from the bus at various speeds, loads, positions, etc. In an effort to determine what a motorist might experience from typical center of the city operation of the GM municipal bus, a number of runs were made in downtown San Antonio. The test course, located in the heart of the shopping and business district, consisted of two patterns: (1) a right pattern involving right turns and mostly right curb lane driving, and (2) a left pattern including left turns and left curb lane driving. These patterns are shown in Figure 7 of Appendix B. Obtained on two separate days under almost identical weather and traffic conditions, the odor intensity ratings were made over the same test course followed during the downtown exhaust dilution experiments. The dilution experiments are discussed later in this report. The results of the downtown small odor panel studies of bus exhaust odor are summarized in Table 9. The idle odor condition does not by itself seem significant. Accelerations straight down the street, generally after prolonged idle, did appear significant sometimes, although the averages were not particularly high. Acceleration around a right corner always resulted in less odor intensity being experienced in comparison to the left turn operation. This can be attributed to the angled position of the horizontal exhaust throwing the exhaust directly into the panel's car on left turns. Constant speed seemed somewhat significant, the overall range being an average odor intensity of 1.7 to 2.5. The significantly higher odor intensity and different, less pleasing, odor quality experienced during decelerations from about 30 to 35 mph and above were only rarely noticed during the downtown experiments.

Additional realistic odor measurements were made by following the bus during typical stop-and-go operation on the Woodlawn bus route. The results of this series of measurements are contained in Table 10. Acceleration after prolonged idle, especially around left turns or corners, plus certain constant speed operation produced the most important odor levels.

b. Intercity Truck

A typical cab-over-tractor Ford powered by a Cummins NH 220, four-cycle, naturally aspirated diesel engine was employed exclusively during these studies. The engine was operated on commercially available No. 2 diesel fuel. The power train consisted of a 10-speed Fuller Road Ranger transmission and tandem single speed Eaton axles. A typical tandem axle, van type (box) trailer was loaded and hooked to the tractor. The purpose of the van trailer was to make the tractor and engine operate under loaded full power conditions and to provide maximum wind resistance, wind turbulence, and frontal area. The tractor-trailer configuration, shown in Figures 2 and 3, is typical and common to those widely used in general freight trucking throughout the country. The van trailer was loaded with sixty 55-gallon oil and fuel oil drums with a total weight of 22, 500 pounds. The total gross weight of the trailer and tractor configuration was approximately 52, 500 pounds. The van trailer was 8 feet wide by 40 feet long by 8 feet high. The box was 3. 5 above the ground. The exhaust stack was located at the right rear corner of the cab. The exhaust exited from a circular cross section, 4-inch diameter stack, 11 feet 2 inches above the ground and 4 inches below the roof of the van trailer.

The results and data obtained with the small panel for the tractor-trailer truck are included in Appendix A. The average panel rating for both odor and smoke are shown in Table 11 for a variety of different typical highway operating conditions. In addition to the operating variables of vehicle speed, engine operation, uphill, downhill, and level terrain, the panel was positioned at various distances behind and/or to the right of the truck. Table 12 summarizes the data of Table 11 by listing all the observed conditions which resulted in a 2.0 or greater smoke rating. It is interesting to note that the maximum power acceleration or constant speed uphill or high-speed level operating conditions are prevalent in Table 12 as producers of heavy smoke. As is evident from Table 11, no significant odor levels were encountered. Utilizing the same odor intensity rating scale as was used in the bus study, no intensities over 1.0 (a trace level) were experienced.

Table 13 lists the initial acceleration-constant speed-deceleration odor and smoke small panel results under a variety of conditions. Little or no odor was experienced, and smoke varied from 0.6 to 1.4 under the level terrain, constant speed, nonlugging engine conditions investigated. Significant smoke was experienced during accelerations, where the maximum smoke appeared generally after upshift and remained longer as the higher gears were used and higher speeds were approached. Table 14 contains small panel odor and smoke evaluations when the truck was operated through the gears normally. No odor was detected, and the smoke intensity and duration of visibility both tended to increase as the vehicle speed increased and as eighth, ninth, and tenth ("overdrive") gears were used.

Table 15 lists data similar to the data of Table 14 which were obtained on an overcast day. The vehicle engine was operated at maximum speed in each transmission gear drive range. No significant levels of diesel odor were experienced during this entire series of experiments. As previously mentioned, the smoke production was less in the lower transmission drive ranges and became more evident and noticeable at the higher speeds and gear numbers. Constant speed operation at maximum engine speed nearly always produced less intense smoke than the following downshift and subsequent acceleration.

In order to investigate further the almost negligible levels of odor encountered during the previous series of experiments, an extensive survey was performed under constant speed conditions (see Table 16). The sky was overcast and cloudy, allowing complete concentration on vehicle exhaust odor. The vehicle was operated at various cruise speeds, and the survey was conducted on both sides and directly behind the trailer from the front bumper of the truck to as much as 140 feet behind the trailer. This survey failed to reveal any significant or even slight levels of odor. The highest level determined was a 1.7 rating during a 0 to 60-mph acceleration.

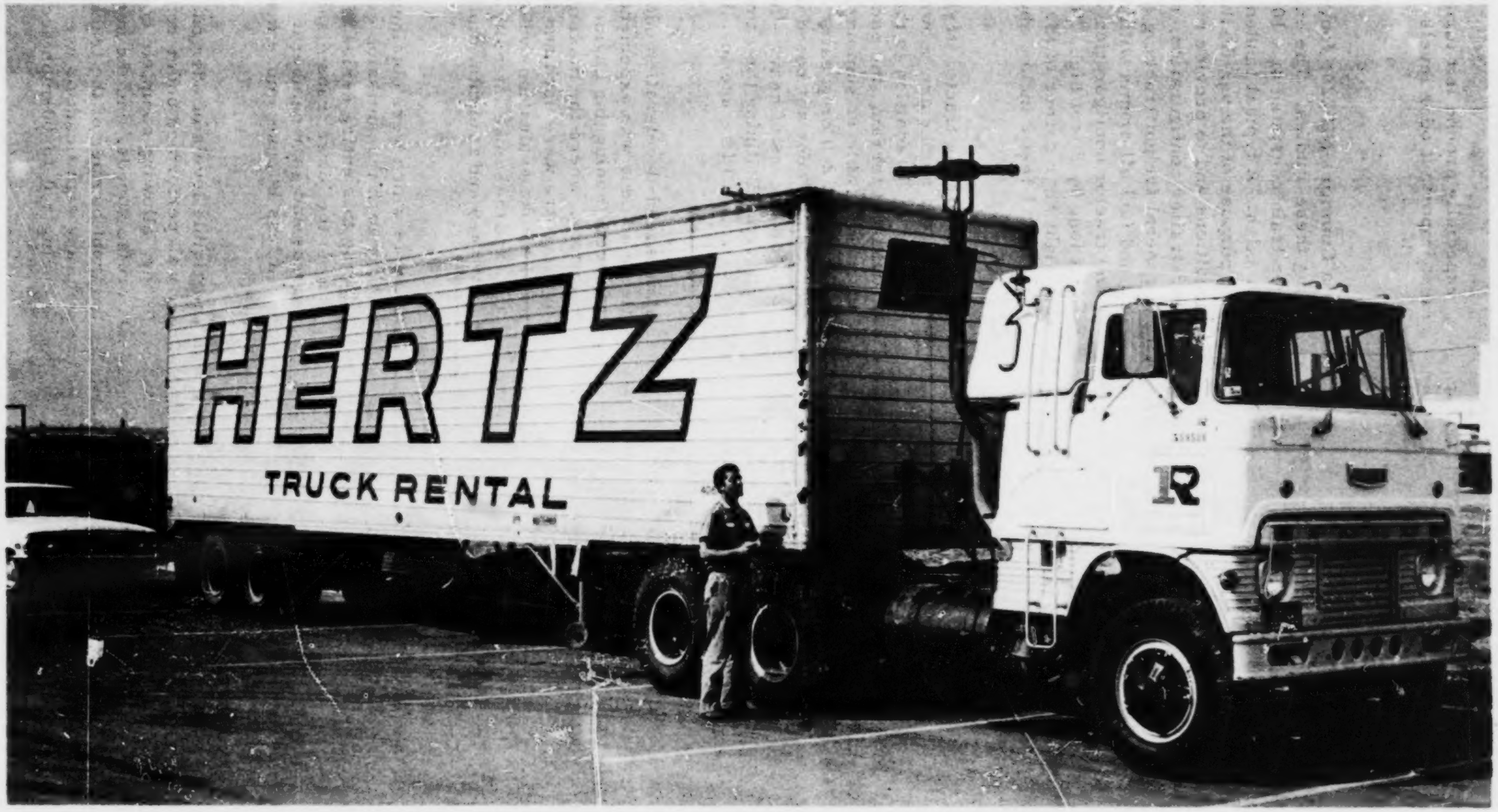

FIGURE 2. TRACTOR-TRAILER TRUCK USED IN FIELD STUDIES
(Small Panel Odor and Smoke and Exhaust Dilution)

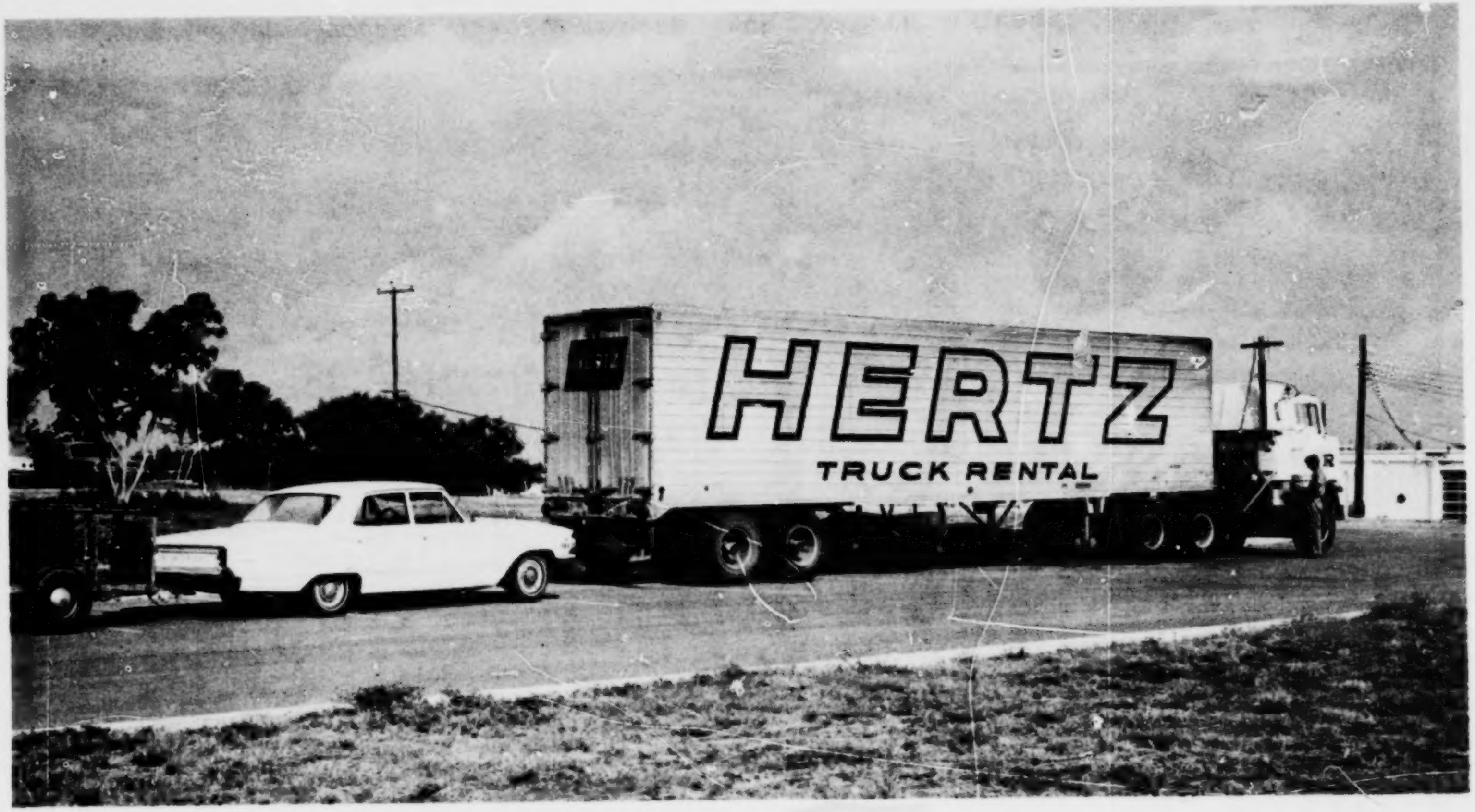

FIGURE 3. TRACTOR-TRAILER TRUCK USED IN FIELD STUDIES
(Exhaust Dilution and Small Panel Odor and Smoke)

Typical operation of the truck on an overcrowded portion of the San Antonio expressway system was conducted, and smoke and odor evaluations were obtained. An analysis of the results of this series of experiments tabulated in Table 17 indicates that the odor intensity was generally less than 1.0, a trace rating, and could be considered nil. Smoke ratings were appreciable when the engine momentarily lugged due to a slight hill and during accelerations. Level cruise under normal engine rpm operation resulted in noticeable levels of exhaust smoke but were substantially lower than during maximum power acceleration and uphill conditions.

Although operation of this size tractor-trailer rig is not common in center of the city shopping and business districts (in most cities they are not permitted or are allowed only if making a delivery), limited downtown data were obtained. These odor and smoke small panel results are summarized in Table 18. The driving pattern and vehicle operation were identical to the downtown exhaust dilution study described later in this report. The driving route, which cut through the heart of the financial and commercial districts of San Antonio, is shown in Figure 2 of Appendix B. Little or no exhaust odor was encountered during the entire sequence of runs. The deceleration condition produced some slight trace of odor that can be considered negligible. The most intense levels of exhaust smoke were experienced during the accelerations from 0 to 20 mph and compare with the data of Tables 13, 14, and 15. The downtown, steady state, 20-mph, cruise condition similarly generated much less visible smoke.

Tables 19 and 20 represent some extreme conditions conducive to the production of exhaust smoke and odor. The truck was operated at various speeds uphill and was downshifted when necessary under lugging and normal truck engine operation. The four-man panel was positioned on the side of the road and was asked to rate the most intense levels of odor and smoke observed. The uphill data are summarized in Table 19 for various speeds and both lugging and normal vehicle operation. The uphill data indicate that very intense smoke could be produced under engine stressing operating conditions, but little odor was emitted. The tractor-trailer rig was then repetitively operated downhill, and the resulting smoke and odor determined. The vehicle was operated at full or near full rack, full power conditions at a given speed on a level or near level road before traveling downhill. At the instant the truck began its descent, the driver took his foot from the accelerator pedal. This resulted in a closed rack deceleration down a steep hill after prolonged maximum rack-fuel delivery conditions. The results of this stringent operation, shown in Table 20, indicate that it is difficult to obtain even slight (2.0 rating) odor levels.

In summary of this portion of the program, it can be reported that little or no exhaust odor was detected by the small panel from the four-cycle diesel powered tractor studied. This conclusion, based on extensive tests with one vehicle, has been informally substantiated from the experience of the panelists, both before and since these tests were conducted for a variety of different truck and four-cycle engine makes. It is noteworthy to compare the relative levels of the two-cycle bus odor and the four-cycle truck odor. It was not difficult to operate the city bus and obtain significant odor producing conditions (3.0 or greater on the intensity scale). The small panel smoke results, however, indicated that the truck investigated produced more black smoke than the bus and could produce it for longer periods of time. The smoke intensity scale used to evaluate the truck stack smoke plume was more severe than the simple 0 to 4 rating system, 4 the most intense noticed, used with the city bus. Although the numerical ratings are not comparable, the use of each system indicated which engine-vehicle operating conditions were most conductive to smoking. The truck appears to smoke most when lugging (engine operating at full rack at an engine speed below that recommended) during uphill maximum power cruise and during acceleration, especially during the last four or five gear ranges. Not only did the smoke intensity become greater but the duration over which this intense smoke was produced was lengthened. Although lugging could produce a significant level of smoke, this type of intentional operation can generally be minimized by improved vehicle operation.

B. Dilution Studies

The objective of this phase is to determine to what extent vehicle exhaust is naturally and normally diluted in the atmosphere due to movement of the vehicle, flow and turbulence of the exhaust, and wind. These studies were designed to result in measurement of actual dilution levels, or dilution ratios, under both static and dynamic conditions.

1. Instrumentation and Equipment

Investigation of atmospheric exhaust dilution depended greatly on the use of a suitable tracer gas technique to measure the dilution at various points on either side and behind moving and stationary vehicles. After evaluation of several alternative trace gases such as N_2O, CO_2, CO, SF_6, and CCl_2F_2 by staff chemists and engineers, it was determined that CCl_2F_2, a commercial refrigerant known as R-12, would be the best trace gas to use. Subsequent discussions with Dr. Amos Turk, Consultant, who has had extensive experience with various trace gases (Ref. 1*) resulted in the selection of R-12 for the dilution studies. This selection was based on the thermal and reactive stability of the gas as well as the ability to continuously monitor low concentrations (0 to 200 ppm) with a Beckman IR 315 analyzer. To monitor the presence of the trace quantities of R-12 in the atmosphere, a Beckman Model 315 nondispersive infrared analyzer was converted to permit measurement of 0 to 200 ppm of R-12 in air.

The function of the trace gas system, shown schematically in Figure 4, was to add to the vehicle exhaust a known mass flow of R-12. The system was capable of adding a fixed flow of trace gas regardless of engine/vehicle operation, or adding trace gas proportional to the exhaust flow (engine speed) or vehicle speed, if desired. The pneumatic automatic control components involved transducing an engine rpm voltage signal to an equivalent 3 to 15-psi signal which in turn opened or closed an infinitely variable control valve. R-12 was vaporized and piped to a point 16 inches from the tip of the vehicle exhaust pipe via the control valve. This system was precalibrated in the instrument laboratory under expected field conditons, and the flows versus valve signal (opening) were determined at a known gas pressure and temperature.

Figures 5 and 6 show the typical relationship of the city bus and the sampling sedan, a 1964 Ford, for street determination of the natural exhaust dilution. The 5th wheel, attached to the bus rear bumper as shown in Figure 5, was used to measure and record the bus (or truck) road speed (acceleration-deceleration, etc.). Please note the stainless steel sampling probes protruding 16 inches from the bumper and hood line of the sedan. This sample system consisted of the six probes as shown, three at the hood level and three at the bumper level manifolded together to obtain a composite sample of the atmosphere immediately in front of the car. The sample thus obtained was then analyzed in a Beckman IR analyzer, converted to measure 0 to 200 ppm of R-12 in air. A Dynapump was used to obtain a 10-CFH sample flow and was placed into the system after the analyzer. The entire sample system was also located and operated at curb side at head level for pedestrian simulation. Samples were also obtained from within the sedan passenger compartment with the windows down and the ventilators open.

2. Test Procedures

The method of determining in the field the exhaust dilution ratio was to admit trace gas at a known flow into the tail pipe 16 inches from the tip of the pipe to ensure adequate mixing. By measuring the engine speed, the engine airflow can be determined from suitable engine airflow calibration curves. Knowing the trace gas flow and the exhaust gas flow, the concentration of the trace gas in the exhaust was computed. The resulting concentration of the trace gas in the atmosphere was then measured by the nondispersive infrared sensitized to R-12 gas. The amount of exhaust dilution, or dilution ratio, was then calculated by dividing the concentration of trace gas in the exhaust flow by the concentration of the trace gas in the atmosphere at the sample point.

3. Results

The results of the study of atmospheric exhaust dilutions for the (1) horizontal exhaust two-cycle diesel powered municipal bus, and (2) the vertical exhaust four-cycle diesel powered tractor-trailer are described in the following subsections.

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*See the "List of References" at the end of this text.

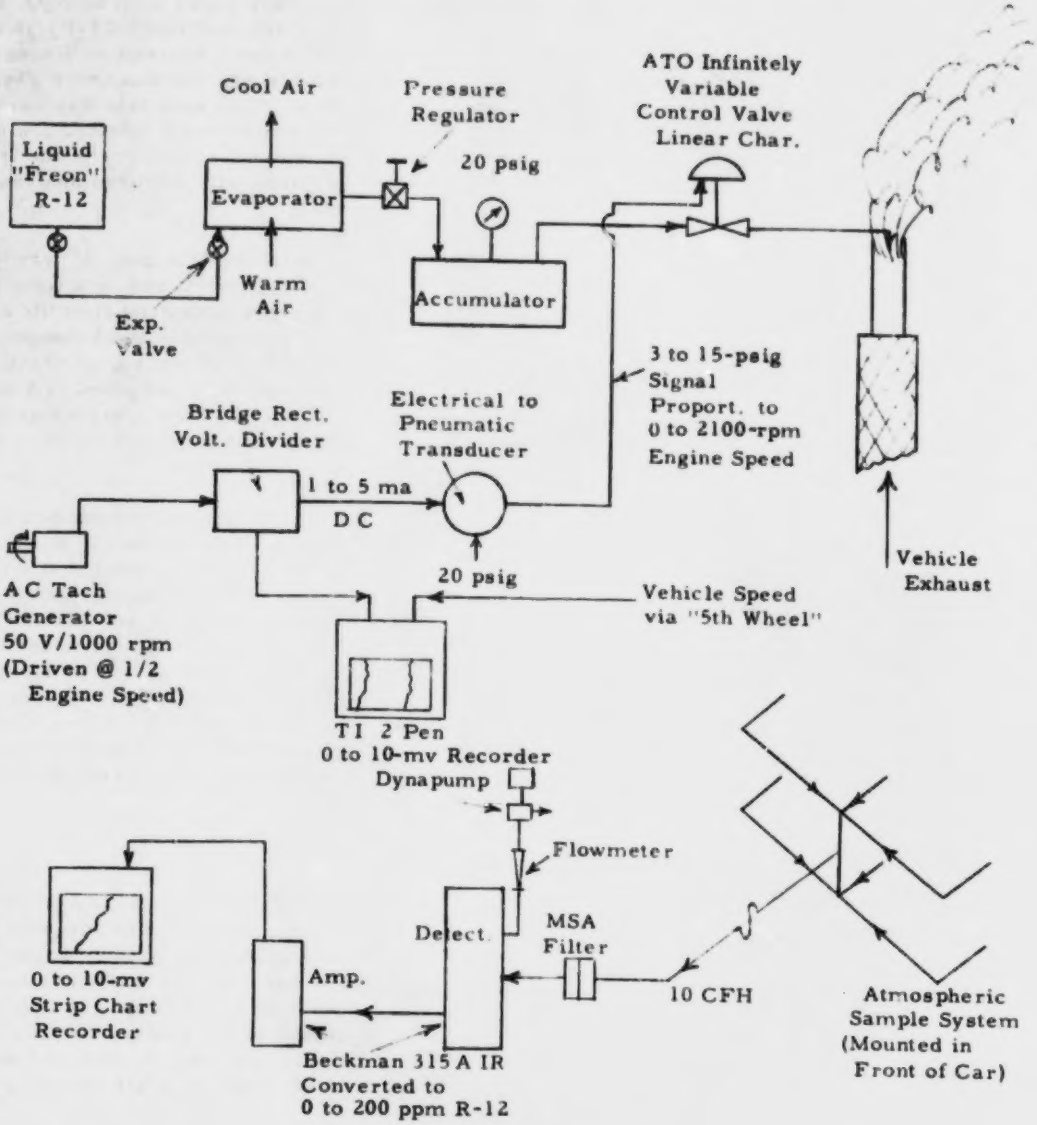
Liquid "Freon" R-12
Cool Air
Evaporator
Pressure Regulator
20 psig
ATO Infinitely Variable Control Valve Linear Char.
Exp. Valve
Warm Air
Accumulator
3 to 15-psig Signal Proport. to 0 to 2100-rpm Engine Speed
Bridge Rect. Volt. Divider
Electrical to Pneumatic Transducer
1 to 5 ma DC
20 psig
Vehicle Exhaust
AC Tach Generator 50 V/1000 rpm (Driven @ 1/2 Engine Speed)
Vehicle Speed via "5th Wheel"
TI 2 Pen 0 to 10-mv Recorder
Dynapump
Flowmeter
MSA Filter
Detect.
Amp.
0 to 10-mv Strip Chart Recorder
10 CFH
Beckman 315 A IR Converted to 0 to 200 ppm R-12
Atmospheric Sample System (Mounted in Front of Car)

FIGURE 4. TRACE GAS SYSTEM FOR FIELD STUDIES OF NATURAL DILUTION OF EXHAUST

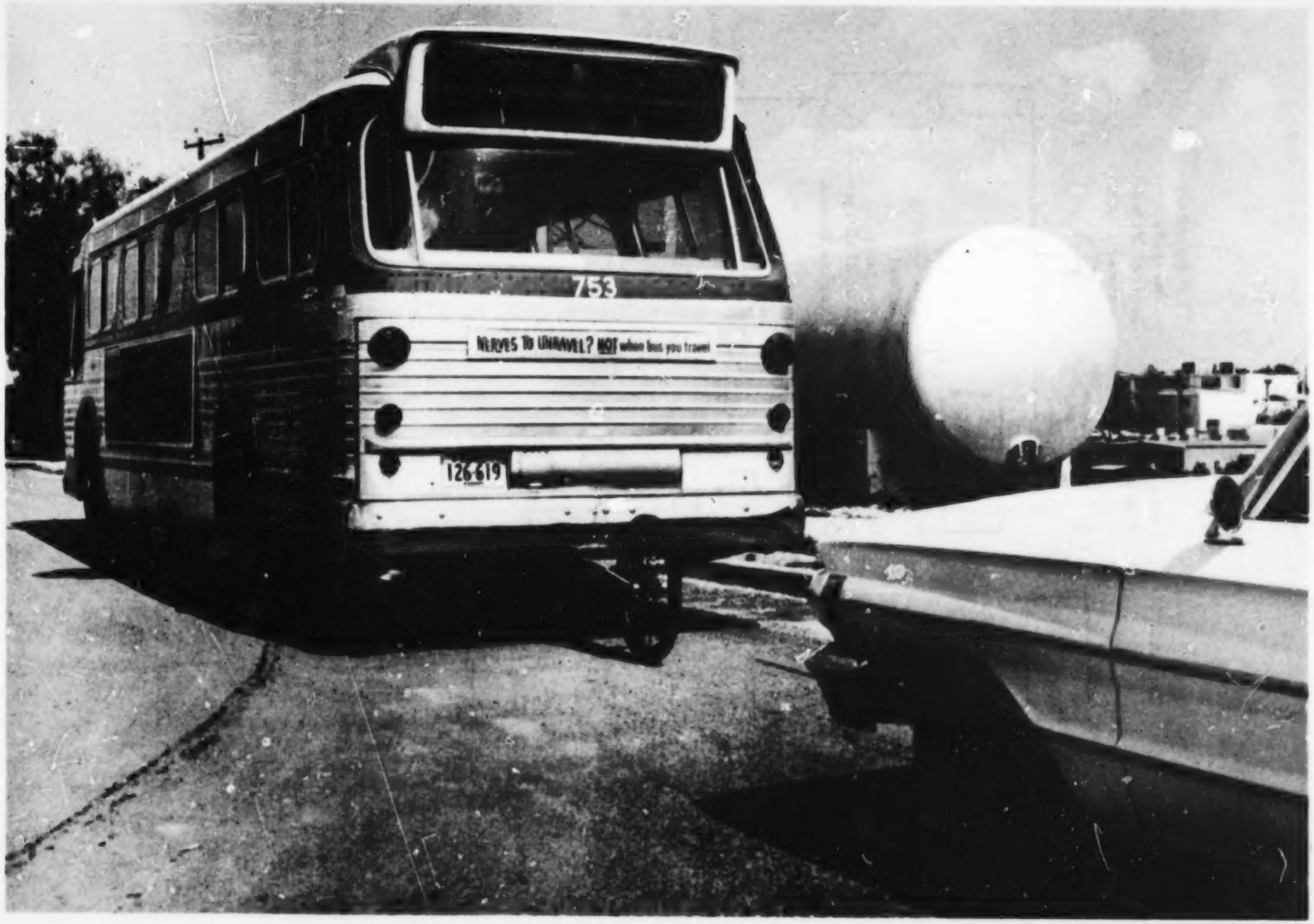

FIGURE 5. PREPARATIONS FOR FIELD STUDY OF NATURAL DILUTION OF VEHICLE EXHAUST

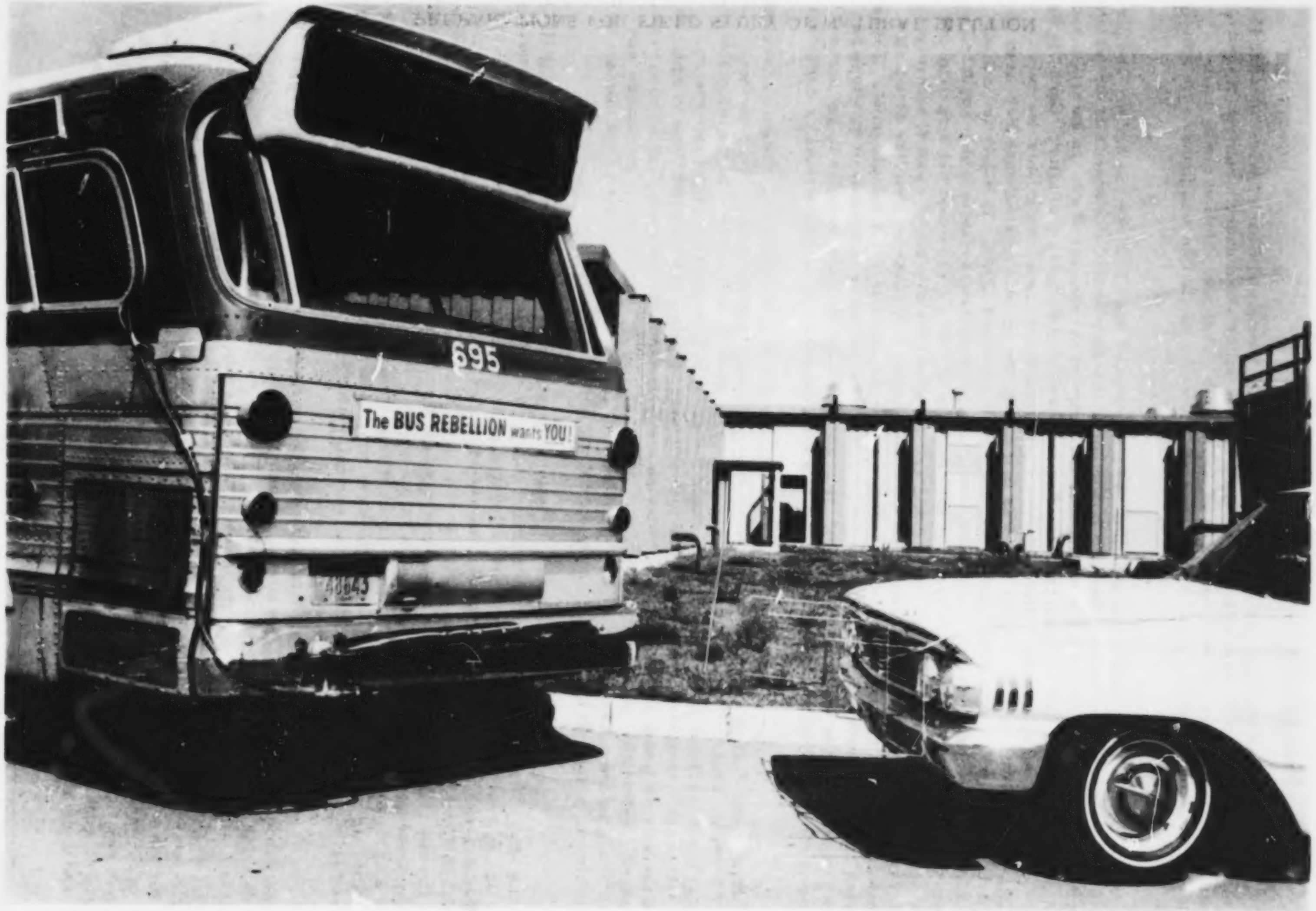

FIGURE 6. ATMOSPHERIC DILUTION OF VEHICLE EXHAUST

a. Municipal Bus

The results of the dilution survey of a GM Truck and Coach Division Model 4519 municpal bus are included in Appendix B*. Dilution ratios, ascertained under a number of operating conditions, are tabulated in the thirteen tables of Appendix B. Although dilution ratios as low as 25:1, as high as 4000:1, and to infinity were measured; the range of dilution was found to lie mostly between 100:1 to 1000:1

Tables 1 and 2 contain dilution data recorded when both the bus and the sample point were stationary. The Table 1 data are important in that they first of all showed that the system was operable and that, under calm air conditions, the throw of the exhaust due to its direction and exhaust gas flow velocity had a significant effect on the level of atmospheric dilution. Once the bus was located so that the exhaust was directed over a lawn and the throw of the exhaust was visible by the grass movement. As the engine rpm was increased, the throw of the exhaust increased up to approximately 40 to 50 feet under open rack, maximum governed speed. It is felt that exhaust pipe geometry, size, cross section, direction, etc., are all possible variables which could influence the amount of dilution experienced. The dilution data of Table 2 show that the direction and velocity of wind was another variable which could greatly affect the dilution of exhaust that might be experienced. Very little dilution occurred when the sample was obtained from the direct flow of the exhaust or when the prevailing wind tended to carry the exhaust to the sample point. These two series of experiments pointed up the immense number of variables in a study of this type and the importance of holding constant as many of these variables as possible in order to get some engineering idea of realistic dilution levels that might be experienced by pedestrians or motorists.

Tables 3 through 6 summarize the results of a series of experiments where the bus would idle and then accelerate away from or by a stationary sample point. Samples were obtained from the front of the car using the six-probe manifold, a single probe in the middle of the front seat (head high), or alongside the road much the same as a pedestrian might experience. Tables 7 through 9 contain the dilution ratios obtained under constant speed conditions in which the bus and the sampling and analysis car were moving. For distances of interest, the dilution ratios fell generally within the 100:1 to 1000:1 range. Also, the traffic lane in which the sample was obtained appeared important. For the bus in the normal curb lane, the dilution of the exhaust was generally lower in the left lane than directly behind or to the right of the bus

Idle-acceleration-constant speed dilution data were obtained at various distances behind the bus. These data are summarized in Table 10 for the probe manifold mounted in front of the car and in Table 11 for the sample probe located in the middle of the front seat. The dilutions measured during bus acceleration ranged between 100:1 to 400:1 for the probe in front of the car and 100:1 to 500:1 for the probe located inside the car. The additional constant speed data showed that as the distance between the bus and car increased, the dilution ratio increased. The idle data generally were associated with high dilution ratios unless a slight breeze blew the exhaust directly into the sample probes or the car. These data seem to confirm the curbside data obtained by the small four-man panel previously discussed. Only on occasion did the idle represent a significant odor condition, and there seemed to be many variables which affected the dilution and odor intensity.

Exhaust dilution data were obtained during the 6 AM to 10 AM rush traffic in downtown San Antonio. Table 12 contains a summary of some of the dilution data obtained under the most realistic operating conditions possible. The entire dilution sampling train consisted of the specially modified bus, the six-probe front manifold equipped sedan plus a trailer mounted 5-kw power generator, upscale, and zero gas instrument calibration/check cylinders. The driving route was representative of normal bus operation in downtown traffic with maximum sustained speeds of 15 mph. The downtown area was split into two patterns, as shown in Figure 1 of Appendix B, each approximately 1 mile in length. The right pattern consisted of all right turns, and either right curb lane or center lane driving as noted. The left pattern consisted of all left curb lane or center lane driving. During both patterns, numerous idle, acceleration, constant speed, and deceleration type of vehicle operation, similar to normal bus operation, were encountered. Therefore, the data were averaged by route pattern either left or right. Deceleration occurred rapidly, generally with braking, so that no deceleration data could be obtained. Practically all these data were obtained under periods of extreme heavy traffic and dead-air calm weather conditions. The downtown data, fairly near the bus because of the traffic condition, corresponded generally on the low end of the previously obtained idle-acceleration-constant speed data. This was to be expected because the tall buildings and heavy traffic conditions reduced the volume of air available for dilution.

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*All of the tables called out in this section, "II. B. Dilution Studies," are presented in Appendix B.

Table 13 is similar to the Table 12 downtown data except these data were obtained on the Woodlawn bus route. The dilution of bus exhaust under normal bus route conditions of the idle-acceleration-constant speed-deceleration was measured. Dilution data were obtained with the front manifold and the sample probe located in the front seat. The dilution levels thus measured seemed to agree well with the previous idle-acceleration-constant speed data and were somewhat higher than the Table 12 downtown data.

In summary, the results of the bus dilution survey indicate that a person in a car or on the curb could generally experience a dilution of 100:1 to 1000:1 under realistic, normal conditions.

b. Intercity Truck

Although the results of the bus study indicated a 100:1 to 1000:1 dilution ratio range, the results of the vertical stack equipped diesel tractor-trailer, shown in Figures 2 and 3, indicated significantly higher dilution or lower concentrations behind and beside the truck. The dilution ratios, ascertained under a number of operating conditions and at various distances behind and on either side of the truck, are tabulated in Tables 14 through 21.

Before discussing the truck dilution results, however, some clarifying comments must be made regarding the instrument procedure used and its range of usefulness. The basis system, described previously, was designed in conjunction with horizontal exhaust systems and intended to measure 0 to 2000 ppm of R-12 in air. For the bus dilution studies, this range of detection was satisfactory to permit measurement of dilution ratios to about 4000:1 with a satisfactory level of confidence. Above this ratio, the concentration of trace gas in the atmosphere was too dispersed, and thus the readability of the resulting strip chart record was difficult. During the initial exhaust dilution studies with the exhaust from the truck vertical stack under static conditions, it became evident that the trace gas, with a molecular weight of approximately four times that of air, was being thrown fairly high into the atmosphere and was probably well dispersed by the time it reached the sample point. In short, it was difficult to satisfactorily detect the trace gas at the 0 to 200-ppm range under stationary vehicle conditions. In an attempt to improve the sensitivity of the detection of the trace gas, 50-percent more trace gas was admitted to the exhaust, and the infrared instrument was calibrated to measure 0 to 125 ppm of R-12 in air. This permitted the measurement of higher dilutions up to approximately 8000:1 with reasonable confidence. As can be seen in Appendix B, a few dilution ratios higher than 8000:1 were calculated and reported. Caution is advised in the analysis and use of these data due to the lack of suitable low instrument ranges with the 13-inch infrared cells. Addition of trace gas to the exhaust was near the peak capacity of the system, and to conduct the tests, most of which are reported or summarized in Appendix B, required almost 300 pounds of liquid R-12. A close-up view of the trace gas addition automatic control valve and the point of gas addition to the vehicle exhaust are shown in Figure 7.

Although dilution ratios as low as 500:1, as high as 17,000:1, and to infinity were measured, the range of dilution was found to lie mostly between 700:1 to about 7000:1. Although time did not permit a rigorous analysis of the reduced data, the following general comments can be made. Tables 14 and 15 contain dilution data where both the truck and the sample point are stationary. The Table 14 data are significant in that they indicate that under ideal, calm conditions, the exhaust from the vertical stack was highly dispersed in the atmosphere, and the dilution was substantially higher than with the horizontal type exhaust pipe. There was an appreciable throw of the exhaust vertically above the 11-foot high stack which tended to assist in diluting and mixing the exhaust with the atmosphere. These same indications were found, Table 15, when the sample was obtained from the center of the front seat at head level instead of from the six-probe manifold located at the

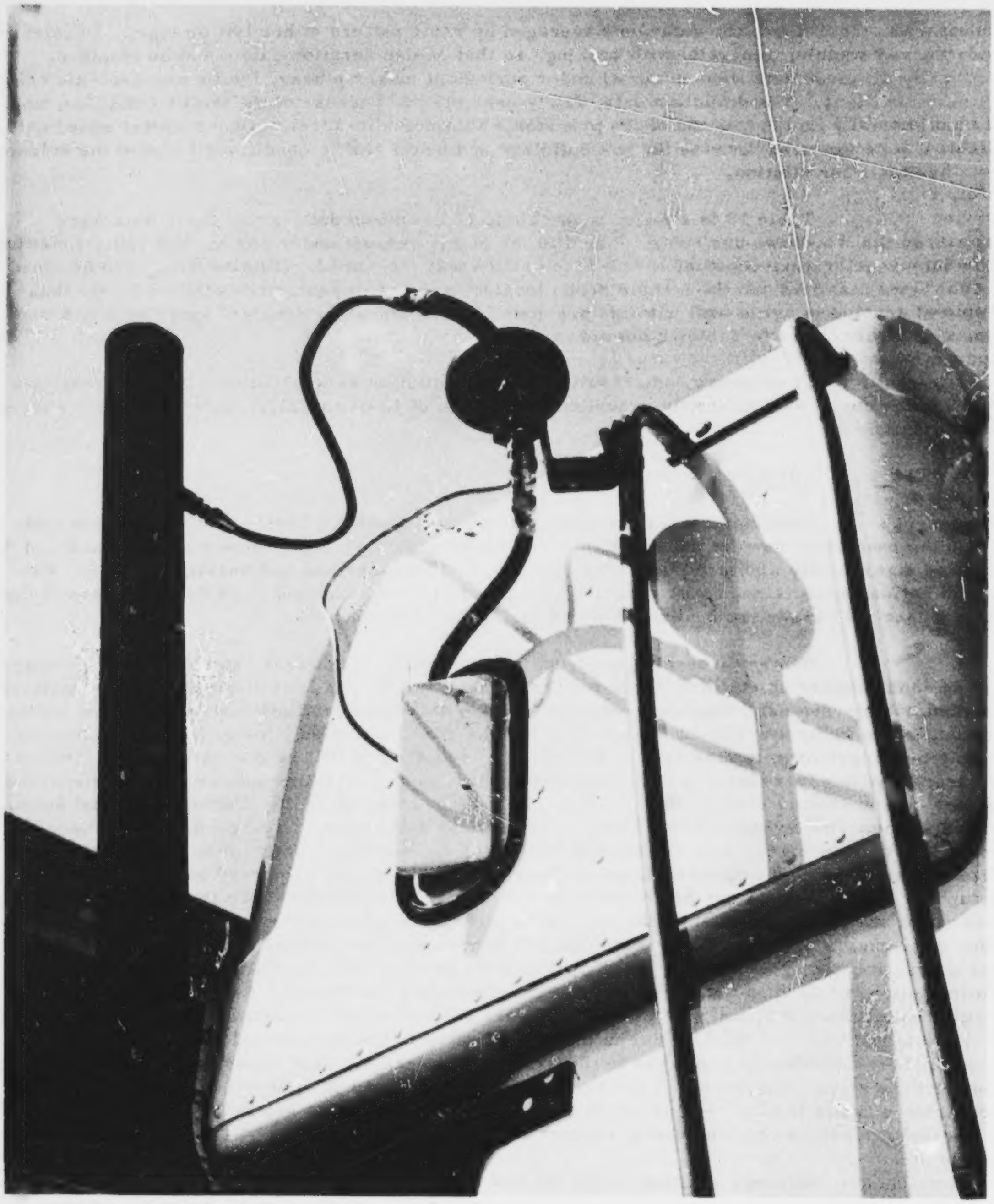

FIGURE 7. AUTOMATIC CONTROL VALVE FOR ADDITION OF R-12 TRACE GAS TO TRACTOR EXHAUST STACK

front of the car. The probe-in-car data of Table 15 also show that the dilution levels experienced inside the car were somewhat higher than those in front of the sedan.

Exhaust dilution results under constant speed cruise vehicle conditions are listed for the front mounted probe system, Table 16, and for the probe in car, Table 17. These results indicate that, under moving conditions, lower vehicle exhaust dilution ratios were measured than when the truck was stationary. This may be attributed to the effect of the wind vector at approximately right angles to the exhaust tending to bend the exhaust over the top of the trailer rather than allowing the exhaust to go straight up. In several cases, especially at speeds of 30 mph and above, it appeared that the distance directly behind the box-like van trailer was important. It seems that if the sample were obtained at say ten feet behind the trailer, this reading would be higher than the 20 and 30-foot dilution levels. The dilution level would, of course, increase to infinity as the sample distance was increased. Little difference was noticed in dilution ratios obtained in the left lane, right lane, and center lane (relative to the truck) at comparable distances behind the truck. Apparently, the movement of the large frontal area (64 square feet) of the trailer through the air generated sufficient turbulence and promoted good mixing. The dilution levels were mostly higher when the sample was obtained from the front seat of the sedan than when the sample was obtained from the atmosphere in front of the car.

The tractor-trailer rig was accelerated from rest to 60 mph and dilution levels obtained at various distances behind the trailer. The results of this series of experiments, for both front of car and interior car samples, are listed on Table 18. Note that the idle dilution data were high, especially for the front seat samples. As the truck accelerated, however, the dilution ratio decreased at 20 mph and 40 mph for all positions and sample distances studied. Apparently, the configuration of the truck, its shape, size, and frontal area, as well as the vehicle speed, had a significant effect on exhaust dilution.

The exhaust dilution data reported so far were obtained under representative driving conditions or conditions which might represent one part of a typical driving operation. This was done to determine the overall general range of dilution ratios. In order to obtain exhaust dilution data more indicative of routine truck operation, several series of experiments were conducted under typical operating conditions in the heavy traffic usually experienced in (1) city truck routes, (2) center of city expressway routes, and (3) downtown stop-and-go driving. The results of these test series are summarized in Tables 19, 20, and 21, respectively. The typical truck route operation involved driving into San Antonio through residential light business areas, through the center of the city on truck routes, and then out of town on an expressway. The truck was then driven back into town through residential areas, through the center of the city, and then out of town through residential-light-commercial areas. It was interesting to note the fairly low 500:1 to 900:1 dilution ratios measured on the eastbound expressway, IH10, portion of the route. These lower dilution levels may be attributed to the effect of vertical retaining walls on both sides of the expressway and a large number of overhead bridges which may have tended to limit the natural dilution experienced in open or less confined spaces. The typical truck route data confirmed previous representative dilution levels in most cases.

Table 20 is a tabulation of the exhaust dilutions measured during a series of repetitive runs over the oldest and narrowest sector of the San Antonio Expressway system. During bumper-to-bumper traffic, exhaust dilution levels were measured at various distances behind the trailer and at various cruising speeds. The average dilution ratios shown tend to confirm the previously discussed eastbound expressway data of Table 19. To round out the dilution survey, limited data were obtained within the financial-business district of the center of San Antonio. Figure 2 of Appendix B shows the shape of the approximately 2-mile long center of San Antonio driving route. Although this operation is not representative of intercity through truck traffic (they are forbidden on these streets unless making a delivery), this area does have tall buildings and high population exposure. Summarized in Table 21 are the maximum, minimum, and average dilution ratios determined for various accelerations, cruise, and deceleration conditions typical of stop-and-go, 20-mph maximum speed, center of city driving. It should be noted that in addition to the front of car samples being less dilute than those within the car, the steady 20-mph cruise dilution was less than the dilution during acceleration.

In summarizing this portion of the program, it can be stated that significantly high dilution occurred from the typical tractor-trailer truck with an 11-foot high, 4-inch diameter stack. In comparison to the dilution levels measured from the horizontal exhaust municipal bus, it appears that the dilution of the exhaust was about seven times that of the bus. Instead of a range of 100:1 to 1000:1 for the bus, the truck dilution ratios ranged from 700:1 to 7000:1. Similar to the bus, the configuration, geometry, and design of the exhaust tailpipe tip may influence greatly the normal and induced dilution of the vehicle exhaust. The same stipulation should be made regarding extrapolation of the exhaust dilution values reported for the one typical widely used truck rig. There are many varieties of engine vertical stacks and outlet configurations, and, of course, the shape and size of the tractor and the trailer may be expected to influence the level of exhaust dilution. One overriding trend appears evident, however, that the vertical stack seems to do a better job of dispersing and diluting the vehicle exhaust. Application of vertical stacks to buses is not new, however, and merely directing the bus exhaust vertically up from the stack may have little effect on the odor levels from busses. This approach may, in conjunction with other techniques, reduce the odor from the city bus.

III. FACILITY DEVELOPMENT

Studies of diesel exhaust smoke emissions and particularly odor have been seriously restricted by the lack of suitable equipment/instruments for their measurement. A major portion of this program was directed toward the development of special facilities and systems to permit a realistic and repeatable measurement of diesel exhaust odor and smoke. It should be noted that there is no objective instrumental method presently available to measure diesel exhaust odor, and only recently have smokemeters been developed to measure the full exhaust plume. The Public Health Service smokemeter, recently developed to measure the visible plume of diesel exhaust, is described later in this section. The contract requirement to simultaneously subject a ten-person panel to a dilute sample of diesel exhaust under simulated steady state cruise and transient acceleration-deceleration vehicle operating conditions necessitated the development of wholly new techniques, systems, subsystems, facilities and equipment. The remainder of this section describes the facility development phase in three subsections. The first subsection describes the methods furnished by the U. S. Public Health Service for the measurement of odor and smoke. The last two subsections cover the physical facilities for road simulation in the laboratory and odor measurement by a panel of ten people. Additional details regarding the preparations portion of this program are contained in a technical paper, "An Investigation of Diesel Powered Vehicle Odor and Smoke - A Progress Report," by Karl Springer and Ralph Stahman presented at the National Petroleum Refiners Fuels and Lubricants meeting held in Philadelphia, Pennsylvania, September 15-16, 1966.

A. Measurement Methods

This subsection is concerned with (1) the odor measurement technique, and (2) the instrument for smoke measurement provided by the U. S. Public Health Service for conduct of this program.

1. Odor Measurement

There are numerous methods by which a panel of people may be employed to evaluate diesel exhaust odor and a variety of responses that may be obtained from a panel. A discussion of the theoretical basis and practical experience and justification of the use of a group of people to judge diesel exhaust odor is beyond the scope of this report. It should be noted, however, that the Public Health Service early recognized the need to develop an odor panel approach for use by the three PHS programs. Prior to award of the SwRI program, a group of consultants--Dr. Amos Turk, odor consultant; Dr. Ralph Bradley, statistical consultant; and Dr. Dean Foster, research psychologist--were retained to devise a suitable odor panel approach for the measurement of diesel exhaust odor. Dr. Amos Turk, internationally known odor and organic chemist consultant, was engaged by PHS to develop a quality/intensity (Q/I) kit and a panel screening/selection/training manual in conjunction with the Scott Research Laboratory diesel exhaust chemistry program. As a result, a Q/I kit comprised of four qualities and one diesel composite diluted to various concentrations or intensities was developed. (For details regarding the selection, formulation and development of the Q/I kit, please refer to Reference 3 which presents the recommended procedures and tests with which to screen, select, and train an odor panel for the evaluation of the quality and intensity of diesel exhaust.) It should be emphasized that the Q/I kit forms a reference against which the trained odor panel judges and rates the diluted sample of diesel exhaust. This approach was intended to result in an engineering evaluation based on reproducible and reliable standards. This method was not intended as a means to ascertain levels of objectionability or acceptability of diesel exhaust odor to the general public.

A one-day training session was attended by Karl Springer and Orville Davis (Southwest Research Institute), Dr. Turk, Jim Davis (Bureau of Mines), and Lou Reckner (Scott Research) at the Scott Laboratory in Perkasie, Pa., on March 15, 1966. The objective of this training was to review the panel screening and selection tests and to observe the training of the Scott panel to determine various odors separately, and in mixtures of two, three and four unknown components out of eight common odors. Screening, selection and training of the fourteen members of the Southwest Research Odor Panel was in accord with the odor quality/intensity kit description and training manual presented by Dr. Turk at this session (Ref. 3).

SwRI's odor panel initial training effort concentrated on becoming thoroughly familiar with the twelve bottle "D" (overall diesel composite) intensity series and the other four quality standards. Each of these four quality standards ("B" - Burnt and Smoky; "A" - Aromatic and Aldehydic; "O" - Oily; and "P" - Pungent) was diluted to four different intensities. The objective of the intensive training period was to not only familiarize each panel member with the twenty-eight different bottles in her kit, but to commit these various odors and odor intensities to memory. A secondary objective was to sharpen and improve each panelist's confidence in her ability to detect and determine the various standard odors. The "A" - aromatic, aldehydic and the "O" - oily quality standards seemed to give the most difficulty, especially in the weaker concentrations. Another common complaint was the inherent odor of the new plastic squeeze bottles masking the low intensity quality standards. This was particularly evident in the "A" and "O" quality series. It was found that the high intensity end of the "P" - pungent quality series was easier to evaluate if the bottles were squeezed only slightly or not at all.

The panel was then trained to evaluate the components of two- and three-component mixtures of the five qualities. Actual diesel evaluations were then gradually phased in and the formal training gradually phased out. It should be noted that this was not an abrupt transition nor was the requirement for continual training and retraining eliminated. The full complement of fourteen panelists was trained to evaluate dilute samples of diesel exhaust during a period of four weeks. As the procedural development studies began, only ten of the fourteen panelists were used. This was accomplished on a rotating basis as much as practical. Attendance of the fourteen panelists was extraordinary. Although it is difficult to compare this panel with others, it is fair to report that the panel members and the panel as a whole showed steady improvement and above satisfactory performance throughout the program.

2. Smoke Measurement

Figure 8 is a photograph of the U. S. Public Health Service Smokemeter under development for use in their broad studies of diesel powered vehicle smoke. The instrument is intended to measure and continuously indicate the density of the visible plume of vehicle exhaust. As such, the smokemeter may be classified as a full-flow obscuration meter. The Public Health Service unit is similar in principle to the smokemeter under evaluation by the State of California (Ref. 4) and the French UTAC meter described in Reference 5. As shown in Figure 8, a light source is on one end of a collimating tube, and a photoelectric cell is located on the opposite end of the tube. The light source-collector cell assembly is then placed either vertically over the usual 4-inch diameter truck stack, or horizontally behind the usual 3-inch diameter bus exhaust pipe so that the light beam traverses the smoke plume issuing from the stack or pipe. The percent transmittance is then read remotely on a meter shown in the separate instrument cabinet. The meter, intended to correspond to what the public sees, is sensitive not only to the thickness of the smoke plume but the number of smoke particles per unit volume.

B. Odor Facility

Figure 9 is an isometric view of the exhaust sampling, dilution, and presentation arrangement. This figure also shows the close proximity of the test vehicle exhaust and chassis dynamometer road simulation equipment to the odor facility, odor room, dilution blower, etc. The odor facility, for purposes of discussion, may be considered to include: (1) Exhaust Sampling, (2) Dilution and Presentation, and (3) Panel Environment Systems. The design criteria and engineering approach, as well as critical equipment items, were coordinated with the Bureau of Mines Petroleum Research Center to permit the establishment of odor facilities as nearly identical as possible.

1. Exhaust Sampling

The sampling of vehicle exhaust for the purpose of odor evaluation involved some special design criteria as follows:

Sample Point: Common truck/bus stack with minimum distance from exhaust pipe of bus. Sample to be withdrawn from center of stack.

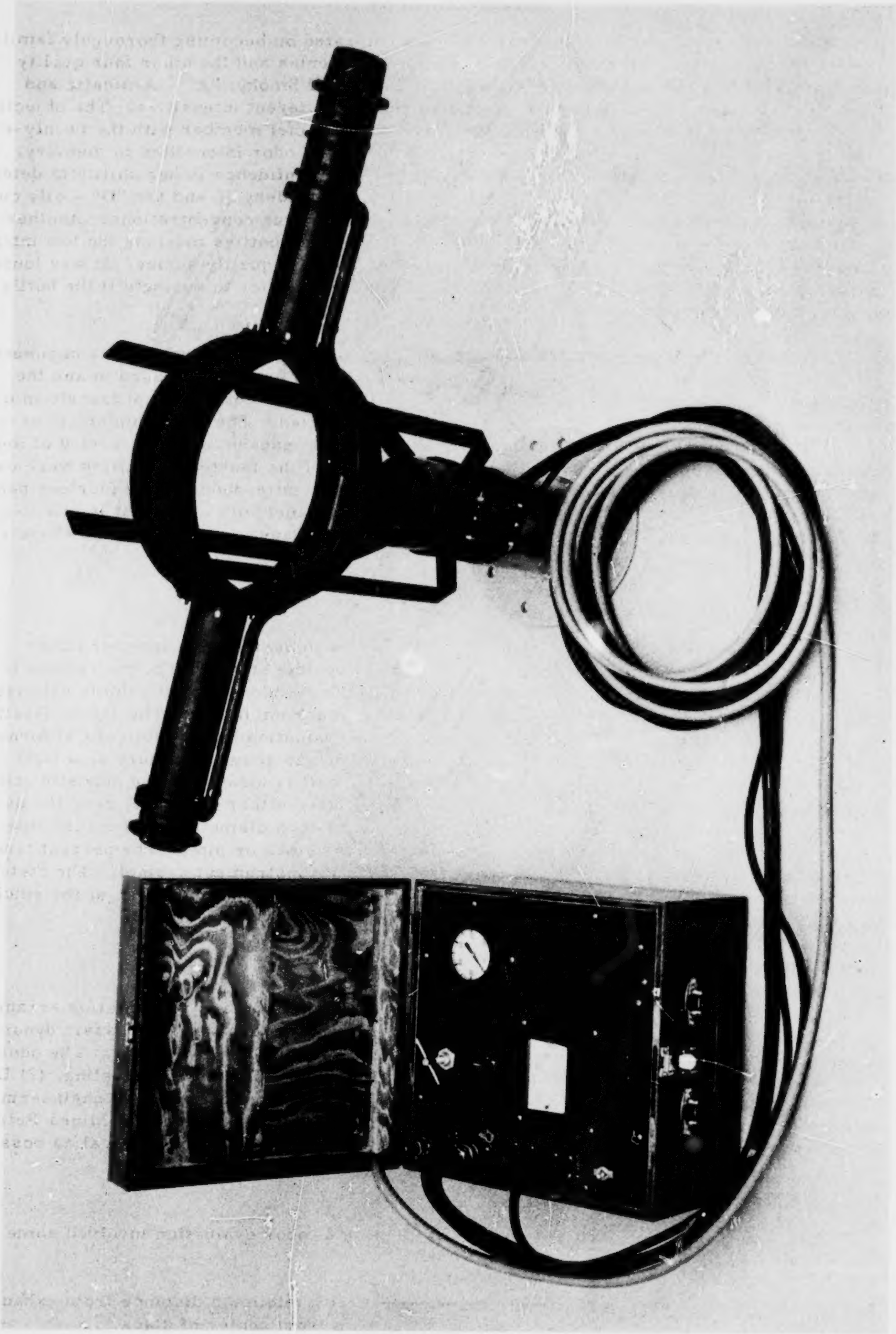

FIGURE 8. U. S. PUBLIC HEALTH SERVICE SMOKEMETER

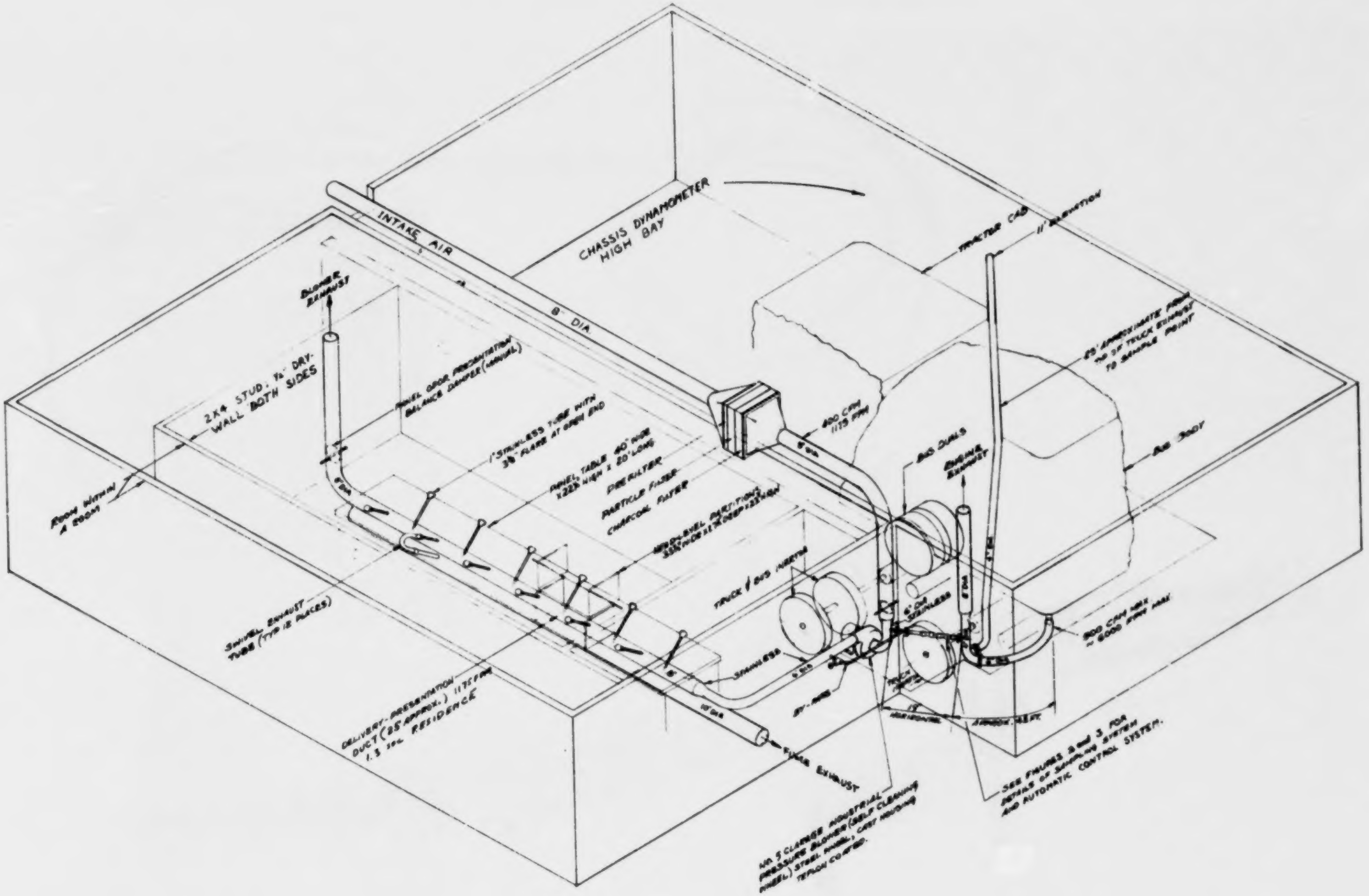
INTAKE AIR
8" DIA
CHASSIS DYNAMOMETER HIGH BAY
TRACTOR CAB
11' ELEVATION
25' APPROXIMATE FROM TIP OF TRUCK EXHAUST TO SAMPLE POINT
BUS BODY
BLOWER EXHAUST
2X4 STUD: ½" DRY-WALL BOTH SIDES
ROOM WITHIN A ROOM
PANEL ODOR PRESENTATION BALANCE DAMPER (MANUAL)
1" STAINLESS TUBE WITH 3⁄8" FLARE AT OPEN END
PANEL TABLE 40" WIDE X 22½" HIGH X 20' LONG
PREFILTER
PARTICLE FILTER
CHARCOAL FILTER
800 CFM
1175 FPM
8" DIA
BUS DUALS
ENGINE EXHAUST
PANEL LEVEL PARTITIONS
TRUCK / BUS INERTIA
6" DIA STAINLESS
8" DIA
800 CFM MAX
≈ 6000 FPM MAX
SWIVEL EXHAUST TUBE (TYP 12 PLACES)
DELIVERY-PRESENTATION DUCT (25' APPROX.) 1175 FPM
1.5 SEC RESIDENCE
10" DIA
STAINLESS
FINAL EXHAUST
HORIZONTAL
APPROX. 18 FT.
SEE FIGURES 2 and 3 FOR DETAILS OF SAMPLING SYSTEM AND AUTOMATIC CONTROL SYSTEM.
NO. 5 CLARAGE INDUSTRIAL PRESSURE BLOWER (SELF CLEANING WHEEL) STEEL WHEEL, CAST HOUSING TEFLON COATED.

FIGURE 9. ISOMETRIC VIEW OF ODOR FACILITY

- Sample Method: Negative pressure by use of dilution blower suction head. The act of removing the sample should not affect the operation of the engine/vehicle.

- Sample Flow Rate: Constant at a predetermined flow rate with provision to adjust throughout the dilution range of interest or proportional to exhaust flow (engine speed). Sample flow range to be 0.2 SCFM to 4.0 SCFM.

- Sample Temperature/Pressure: Compensated automatically.

- General Arrangement and Materials of Construction: Minimum residence and hang-up compatible with physical limitations. Stainless steel construction. No sample heating or other sample treatment that may affect the odor in the sample. Make system cleanable.

Using these criteria as basic guidelines, a sampling system was designed, shown schematically in Figure 10. This system withdraws between 0.2 and 4.0 SCFM of vehicle exhaust either proportional to exhaust flow rate or at a constant rate. Two orifice plates in series were used to control and measure the flow rate. The orifice plate designated ΔP_1 was the primary element of the pneumatic flow control system shown. The ΔP_2 orifice plate, in conjunction with the recycle air, served to maintain a constant maximum total flow of approximately 6 SCFM (4-SCFM sample maximum plus 2 SCFM of return or recycle air) under the constant 6-inch H_2O vacuum dilution blower inlet condition. This system eliminated all moving valves or similar components, other than the two thin plate orifices, from the 1.15-inch OD, 19-inch long stainless steel sample tube.

Automatic control of the sample flow was accomplished by the system also shown in Figure 10. The control system automatically functioned to compensate the measured sample flow for temperature variations between 200 and 800°F. The system permitted a constant mass or SCFM sample flow to be withdrawn regardless of engine/vehicle operating condition or allowed a proportional sample to be withdrawn as a function of engine exhaust flow. As indicated in Figure 10, the control system sensed the 200 to 800°F sample temperature by a means of a sensitive bare element, 30-gage iron-constantan (Type J) thermocouple located in the center of the exhaust stream. With a conventional thermocouple system, the error voltage was then amplified by a solid state operational amplifier (Item 1)* employed in an SwRI circuit design. This amplified error voltage was then transduced to an equivalent 3 to 15-psi signal essentially proportional to the temperature of the sample (200 to 800°F) by means of a Fisher Governor electropneumatic converter (Item 1a). The output of this E/P transducer was then fed into Item 3, a pneumatic computer which divided the 3 to 15-psi signal from the 0 to 5-inch H_2O pressure drop dp cell (Item 2). The square root of the resulting 3 to 15-psi signal, compensated for the effect of the absolute temperature of the exhaust sample, was then obtained in Item 4. The resulting linear, temperature compensated, 3 to 15-psi signal was then fed into the flow controller. The function of this controller (Item 5) was to control the amount of bypass air to maintain a desired, manual set point, amount of exhaust sample. The flow controller sent a 3 to 15-psi signal to the damper operator (Item 6) which raised the flow of bypass air to maintain the required flow of exhaust sample.

When it was desired to withdraw a flow of sample proportional to vehicle exhaust flow, Items 7, 8, and 9 were employed. By knowing the approximate linear exhaust flow versus engine rpm relationship of the diesel engine of interest, a tachometer electrical output from Item 7 could be conditioned via Item 8, a rectifier-voltage divider of SwRI design, and transduced to an equivalent 3 to 15-psi output in Item 9. By use of a special bellows which actuated the desired set point of the flow controller, an increase in engine rpm or exhaust flow could be used to close the bypass air damper and thereby increase the sample flow rate.

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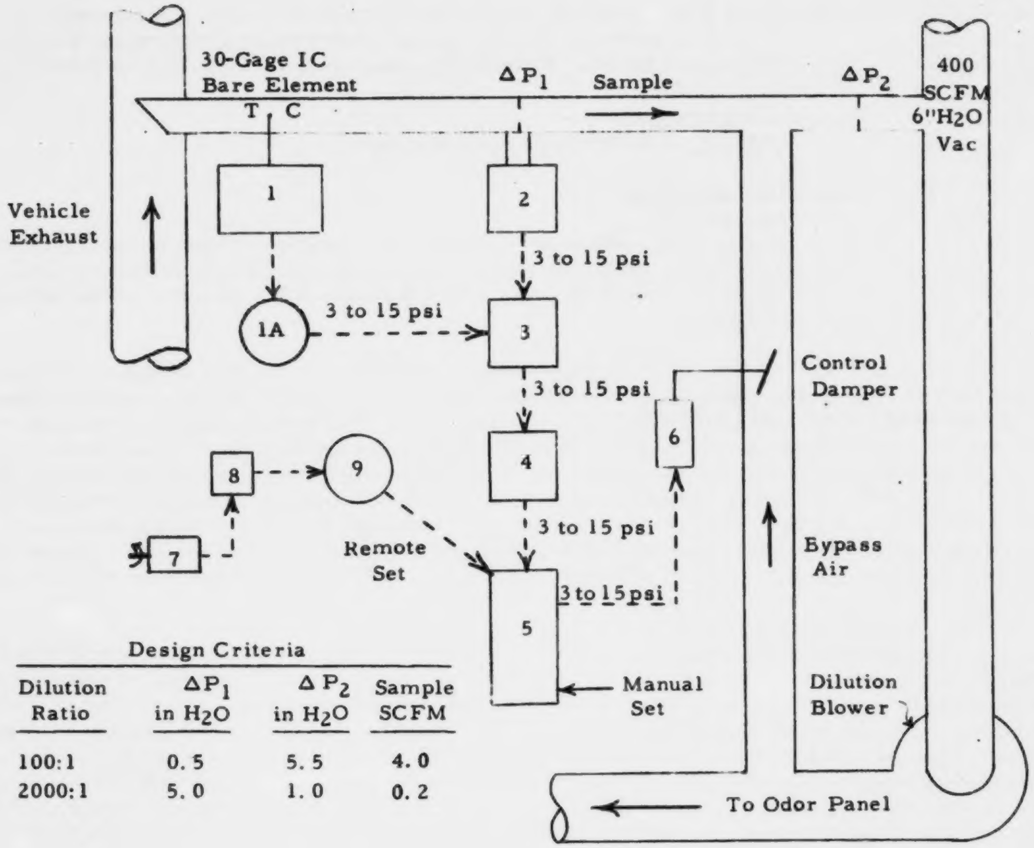
*Item numbers as per Figure 10.



Design Criteria

Dilution Ratio	ΔP_1 in H_2O	ΔP_2 in H_2O	Sample SCFM
100:1	0.5	5.5	4.0
2000:1	5.0	1.0	0.2

Item	Description
1	Operational Type Error Voltage Amplifier, 200 to 800°F, SwRI Design
1a	Fisher Governor Type 546 Electropneumatic Converter
2	Foxboro Model 15A DP Transducer 0 to 5 in. H_2O: 3 to 15 psi out
3	Foxboro Model 556-9-72 Temperature Compensator Divider Relay
4	Foxboro Model 557 Square Root Extractor
5	Foxboro Model 52A Controller w/Remote Set
6	Honeywell Model MP 909A 10412 Damper Operator 3 to 15 psi in.
7	Sticht Model ACA-2 AC Tach Generator
8	Signal Conditioner, SwRI Design
9	Fisher Governor, Type 546 Electropneumatic Converter

FIGURE 10. SCHEMATIC OF AUTOMATIC CONTROL SYSTEM FOR EXHAUST SAMPLING

2. Dilution and Presentation

The dilution system may be characterized as a "dynamic dilution technique" to enable presentation of the diluted sample of vehicle exhaust simultaneously to members of the odor panel. The criteria used in the design and development of the dilution and presentation system are summarized as follows:

- Dilution System: Single stage with constant 400-CFM diluent air with dilution to be effected as quickly as possible near the entry to or within the dilution blower.
- Diluent Air Preparation: Particulate filtered and charcoal filtered. Temperature and humidity to be controlled to 75°F and 50 percent relative humidity, respectively.
- Materials of Construction: Stainless or "Teflon" coated.
- Diluted Sample Handling System: Minimum residence and hang-up. Should be easily cleaned and inspected.
- Presentation of Diluted Sample to Panelist: Sample (1 CFM constant) of diluted exhaust should be removed from the center of the sample handling duct and presented to the panelist at a pleasing velocity with minimum entrainment of odor room air prior to sample being inhaled. Presentation tube/duct should be easily cleaned with minimum residence and hang-up.

Figure 9, the overall isometric view of the odor facility, shows the general arrangement and layout of the odor dilution system and the method of handling and presenting the sample to each of the ten odor panelists. Two views of the dynamic dilution system are shown in Figure 11. Note the central exhaust stack and the two inlets into this stack, one short flexible 3-inch pipe which was connected to the bus and a vertical pipe which was connected to the truck 4-inch stack. Provision was made to blank off the truck inlet when operating with a bus and vice versa. A sample was then obtained from the central stack as shown via a 1-1/2-inch OD by 1.15-inch ID stainless steel sample tube. Prefiltered, particulate filtered, and charcoal filtered diluent air was ducted via the vertical 6-inch diameter stainless steel pipe into the inlet of the "Teflon" coated dilution blower. The diluent air was maintained at a constant temperature of 75°F.

Figures 12 and 13 illustrate the arrangement of the odor room and the diluted sample delivery, presentation, and fume removal systems. Note the 8-inch diameter Type 304 stainless steel duct for delivery of the diluted samples with the 1-inch diameter individual presentation tubes and the 10-inch diameter odor exhaust duct in Figure 13. Figure 14 illustrates the odor panel and exposure facility for simultaneous evaluation of a diluted sample of diesel exhaust. The odor panel, comprised of ten housewives, evaluated the odor quality/intensity of the diluted sample using procedures and standards developed by Dr. Amos Turk, previously discussed. Note the 1-inch diameter, Type 304 stainless steel tube which protrudes from the table top in the center of each cubicle. A portion, 1 CFM, of the diluted exhaust sample passed through this tube and out through the 1-inch diameter to 3-inch diameter diffuser cone. When the panelist exposed her nose and nose area to the gas sample issuing from the diffuser, she rotated up, away from the diffuser, a larger cone connected to a fume removal system. This system is shown in detail in Figure 15. Before developing the dynamometer and odor panel procedures, a fine calibration was performed to determine and adjust the dilution system to known levels. This was accomplished by admitting pure R-12 trace gas into the blower inlet and then monitoring the resulting dilution at the presentation cone. During design and development of the odor facility, numerous different size and shape presentation devices, cones, etc., were considered. Smoke trace studies showed that in all the simple, cleanable, low residence, no hang-up configurations studied, a small amount of outside sir would invariably be entrained even at the relatively low 1-CFM sample presentation rate. Therefore, the fine calibration, using trace gas infrared techniques, was required to accurately determine how much free or room dilution was occurring and to "fine" balance the sample dilution at each station. It was found that 11 percent of the dilution was occurring in the odor room via the inherent presentation cone

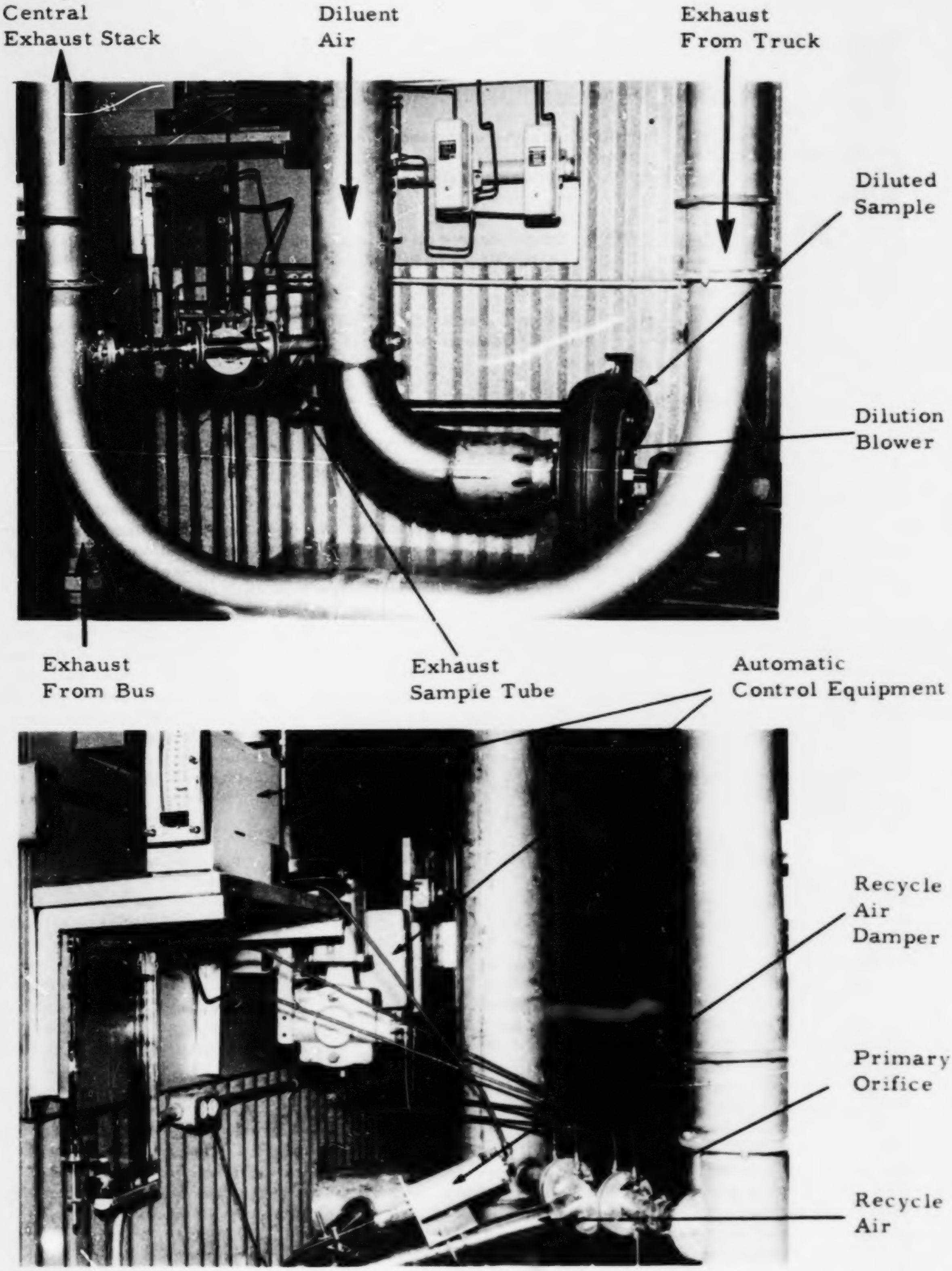


FIGURE 11. DYNAMIC SAMPLING AND DILUTION SYSTEM FOR VEHICLE EXHAUST ODOR DETERMINATION

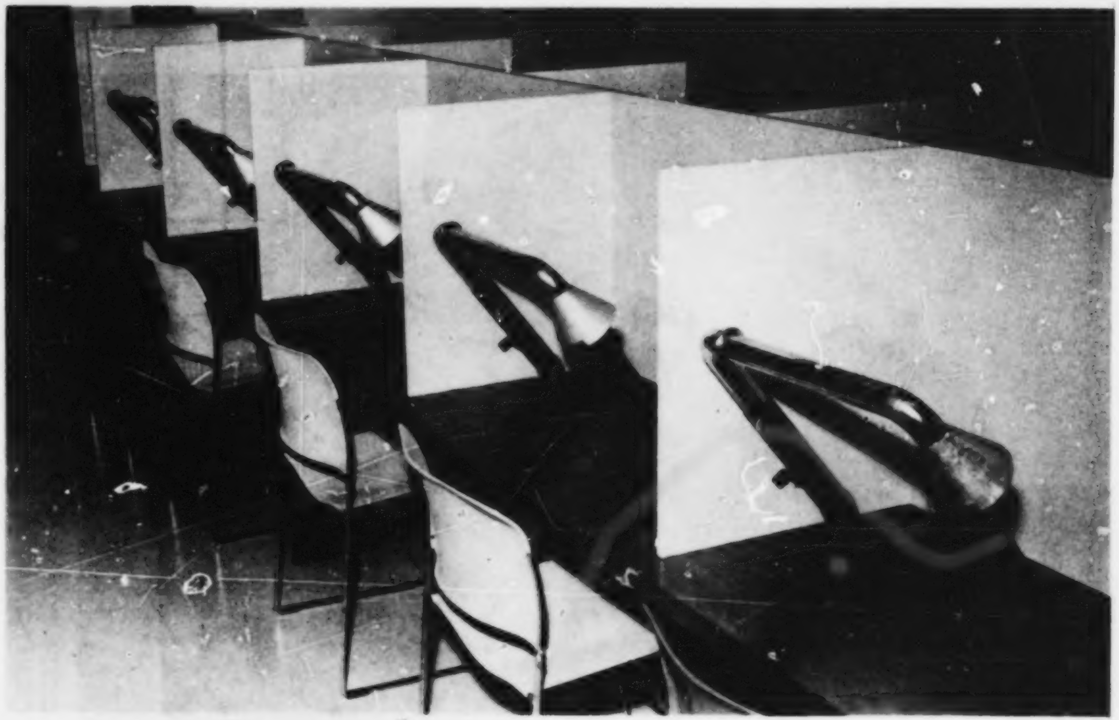


FIGURE 12. ODOR ROOM

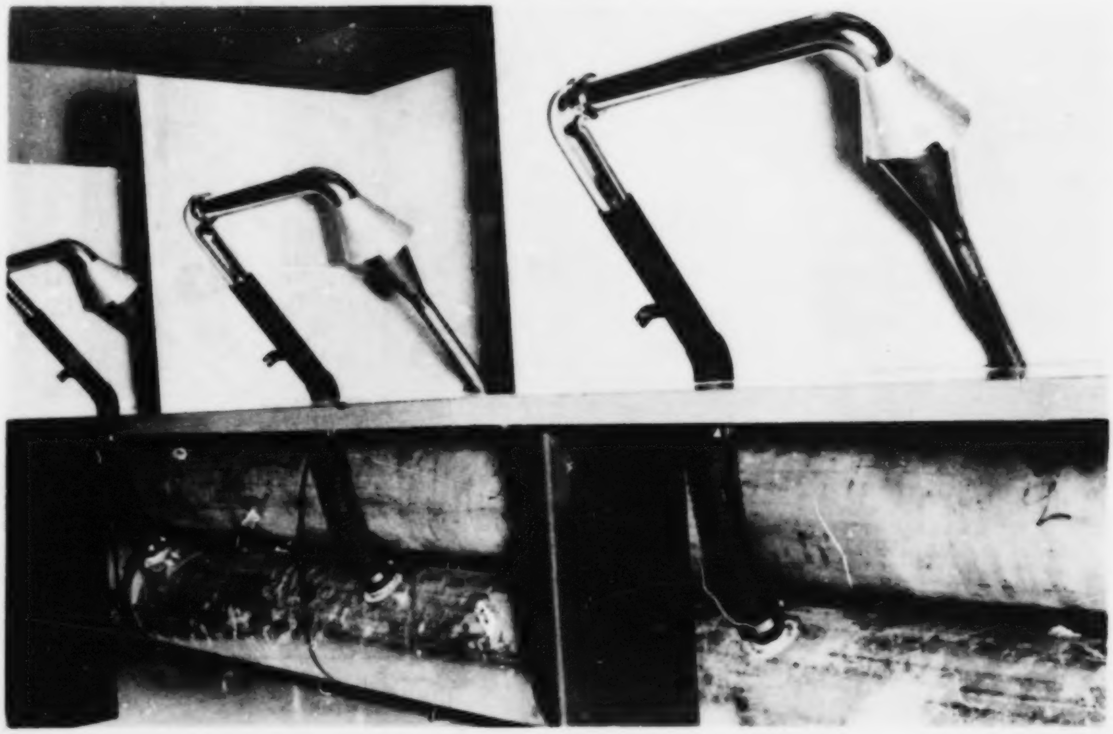


FIGURE 13. ODOR PRESENTATION AND FUME REMOVAL DUCTS

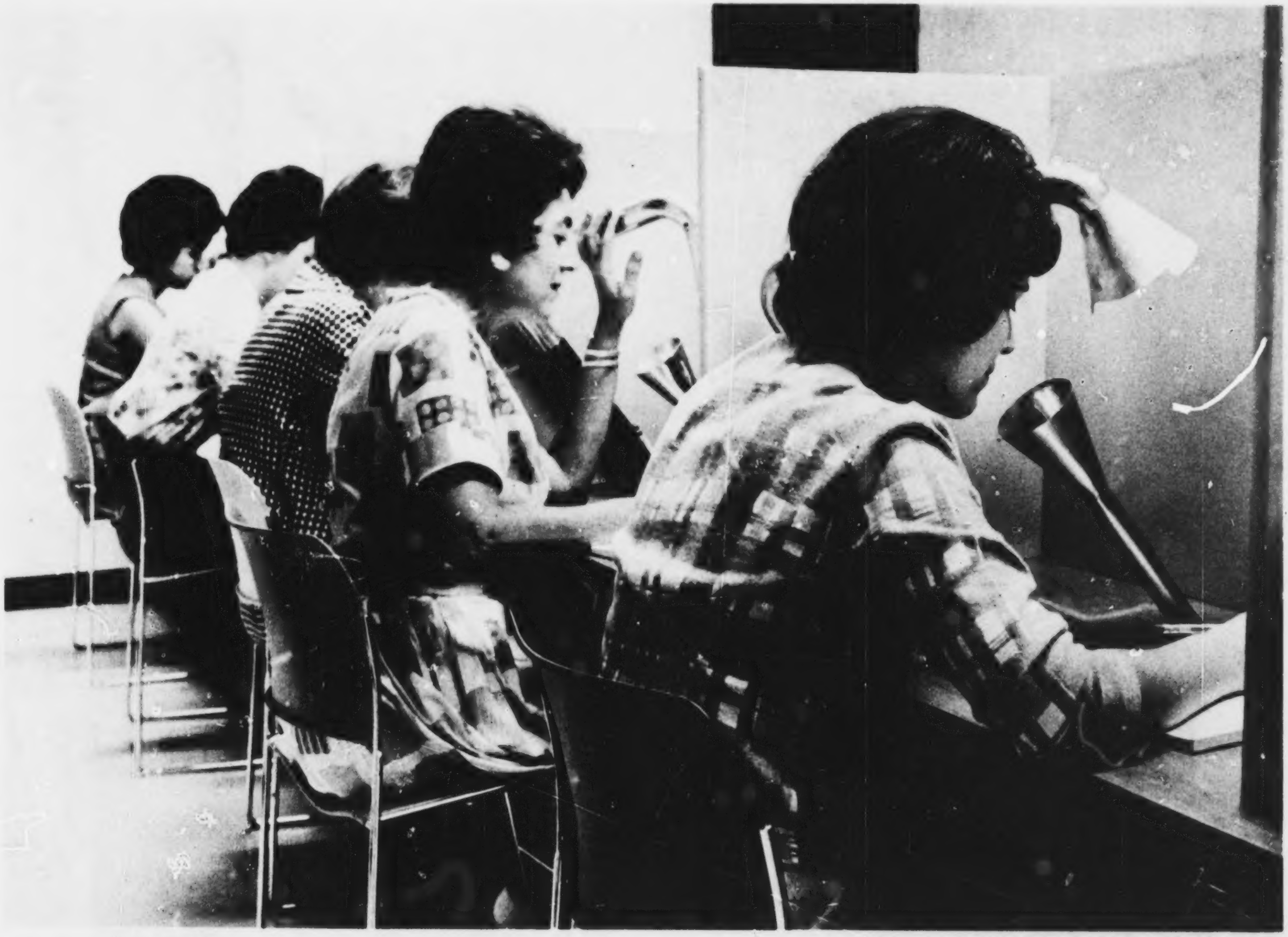


FIGURE 14. ODOR PANEL AND EXPOSURE FACILITY FOR SIMULTANEOUS EVALUATION OF DILUTED SAMPLE ODOR QUALITY/INTENSITY

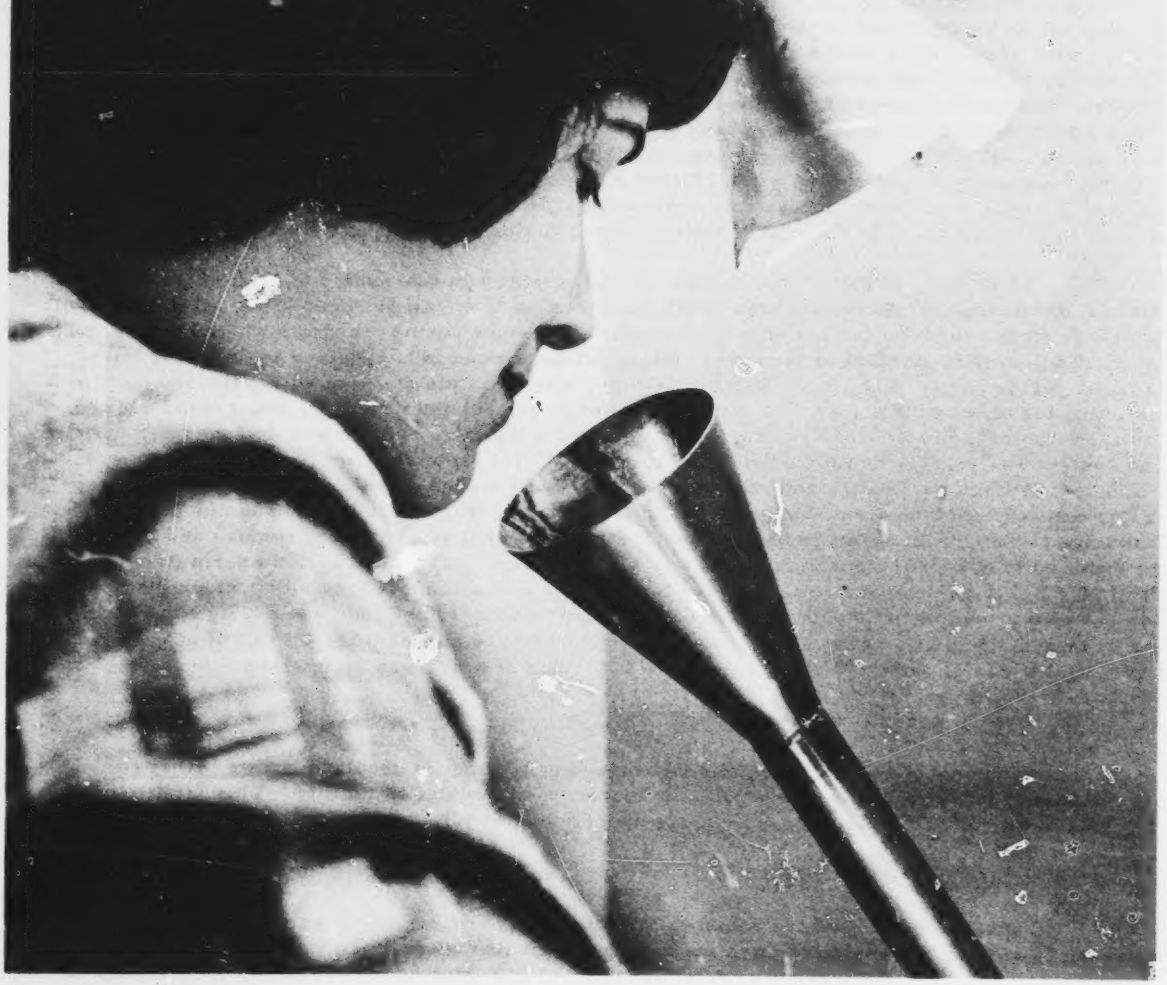


FIGURE 15. DETAILED VIEW OF PANELIST--ODOR PRESENTATION DIFFUSER AND ODOR REMOVAL DUCT

entrainment of room air. To compensate the system for the additional dilution air, the diluent air supply was reduced from 400 SCFM to 356 SCFM. The dilution, checked at three different R-12 levels of 125 ppm, 256 ppm, and 950 ppm, was measured at a point 7/8 inch from the outer edge of the cone in the center using a specially fabricated probe. The sample point was determined by measuring the penetration of several panelists' noses into the presentation cone during normal exposure for sniffing. The odor room temperature was maintained at 75°F ± 2°F, and the odor room relative humidity at 45 ± 3 percent.

3. Panel Environment

To assure optimum panel performance, the major design criteria for the odor room were to maintain an environment as odor free as possible at a constant temperature and humidity. In addition, the sound and vibration level within the room should be within tolerable limits, and the operation of the vehicles on the road simulation equipment in the adjacent high bay area should not be apparent or recognizable to the panelists (see Fig. 9). These requirements dictated that a special odor panel "room within a room" be designed and constructed for this particular program. The outline of this "room within a room" is shown in Figure 9 which gives a general view of the odor facility. The inside dimensions of this facility are: 15 feet wide by 24.5 feet long by 8 feet high with 367.5 square feet of floor area and a 2,940-cubic foot volume. The interior appearance of this room is as shown in Figure 12. To prevent noise transmission from the adjacent chassis dynamometer bay, the existing wall was sealed with 1/2-inch gypsum on both sides of the wall studs. The other walls of the odor room were of identical construction. The ceiling is similarly sealed on both sides of 2 × 8 ceiling joists. The floor is of built-up construction for sound and vibration isolation.

One CFM of the diluted sample was presented simultaneously to each of the ten panelists via stainless steel ducting/tubing. Provision was made to remove practically all of this dilute sample from the room by the individual fume exhaust devices during the times when the panel was not sniffing, over 99 percent of the time. During those few seconds required to raise the fume removal device and sniff the dilute sample, the presented sample did escape into the room. To minimize the effect of this free odor on the room environment and panelist's background odor, a special 4-ton capacity air-conditioning, heating, and air handling system was designed and installed. The system was capable of recirculating up to 1500 CFM of room air (one room air change every 2 minutes) through particulate and charcoal filters. Good design practice for design of odor free rooms calls for recirculation rates between one change per minute (3000 CFM) to one change every 3 minutes (1000 CFM). Additionally, the environment control system could remove and replace in the room up to 800 CFM of particulate and charcoal filtered makeup air. This permitted up to about 60 CFM to be removed at each of the twelve odor evaluation stations. Experience indicated that satisfactory operation could be achieved by recirculating 1400 CFM, and adding approximately 400 CFM of makeup air. The fume removal system removed approximately 30 CFM at each of the twelve stations. A positive room pressure of 0.01 inch of water was maintained.

C. Laboratory Road Simulation Facility

The nature of the odor and smoke measurement techniques required in this investigation necessitated the design and construction of a special road simulation facility. This facility consists of two systems to (1) simulate loaded vehicle operation, and (2) simulate vehicle inertia.

1. Chassis Dynamometer

After a brief study of vehicle road simulation equipment, it was decided that a Clayton water brake chassis dynamometer was the only type unit that could meet the program requirements and be obtained in time to meet the critical schedule of this program. Accordingly, a modified Clayton chassis dynamometer (Model CTFF 200 × 200), capable of handling tandem axle drive truck tractors and absorbing up to 200 hp from each axle, was procured and installed by Southwest Research Institute. Figure 8 provides an overall view depicting the locations of the road simulation equipment relative to the odor facility--sampling, dilution, and odor room, etc. In addition to being capable of absorbing 200 hp from each of two power axles, special large roll shaft trunions and roll bearings were ordered to withstand higher than normal torque. This torque was anticipated when the bus or truck was operated under transient conditions such as a full rack acceleration.

2. Vehicle Inertia Simulation

In addition to simulating on the chassis dynamometer road load and constant power conditions, it was desired to simulate vehicle acceleration under loaded and open rack engine operation. This type of truck/bus simulation was not normally conducted by any of the concerns contacted, including General Motors Truck and Coach Division, International Harvester, or Clayton Manufacturing. As a result, Southwest Research had to design a vehicle inertia simulation system for use in this program. This design was based on compromise criteria of fully ladened vehicle weight versus chassis dynamometer torque capability. The gross vehicle combined weight, State of Texas, is 72, 000 pounds, 32, 000 pounds maximum per tandem, or 16, 000 pounds/axle. To simulate 16, 000 pounds of vehicle inertia required a 6-inch thick, 36-inch OD, 1800-pound, direct connected, solid disc flywheel with approximately 2000 lb-ft^2 inertia. Clayton Manufacturing advised that the truck-tractor acceleration simulation would probably be restricted to gears 8, 9, and 10 because of physical and mechanical limitations. Therefore, it was determined that truck-tractor acceleration would be conducted using approximately 2000 lb-ft^2 inertia (16, 000-pound vehicle weight) per drive axle for a total of 32, 000-pound vehicle weight. Acceleration rates could be further modified by presetting a load in the hydraulic absorber. The gross vehicle weight wet and empty of the GM Model 4519 (45-passenger) Coach is 20, 380 pounds, and the seated wet weight is 27, 130 pounds. Assuming 60 percent utilization, the average vehicle weight is 24, 430 pounds. Since bus acceleration is via a torque converter and it would be difficult to modify the acceleration rates by means of additional power absorption, especially at very low speeds, it was decided to simulate the entire 24, 430-pound average bus weight inertia. This was done by use of an additional solid disc flywheel connected to the front stationary dynamometer absorber truck inertia flywheel.

Figure 16 shows a 45-passenger bus on the chassis dynamometer. When vehicle inertia simulation was desired in addition to road load power absorption, the large fixed inertia wheels, shown in the pit adjacent to the flush mounted chassis dynamometer, were operated. The two wheels shown are capable of simulating the inertia of the bus--24, 430 pounds. The larger wheel (on the left) is capable of simulating 16, 000 pounds of vehicle inertia. This wheel plus an identical wheel not shown but coupled to the rear movable roll are, in combination, capable of simulating 32, 000 pounds of truck inertia. It should be mentioned that this road simulation equipment was successfully used on both diesel powered trucks and buses.

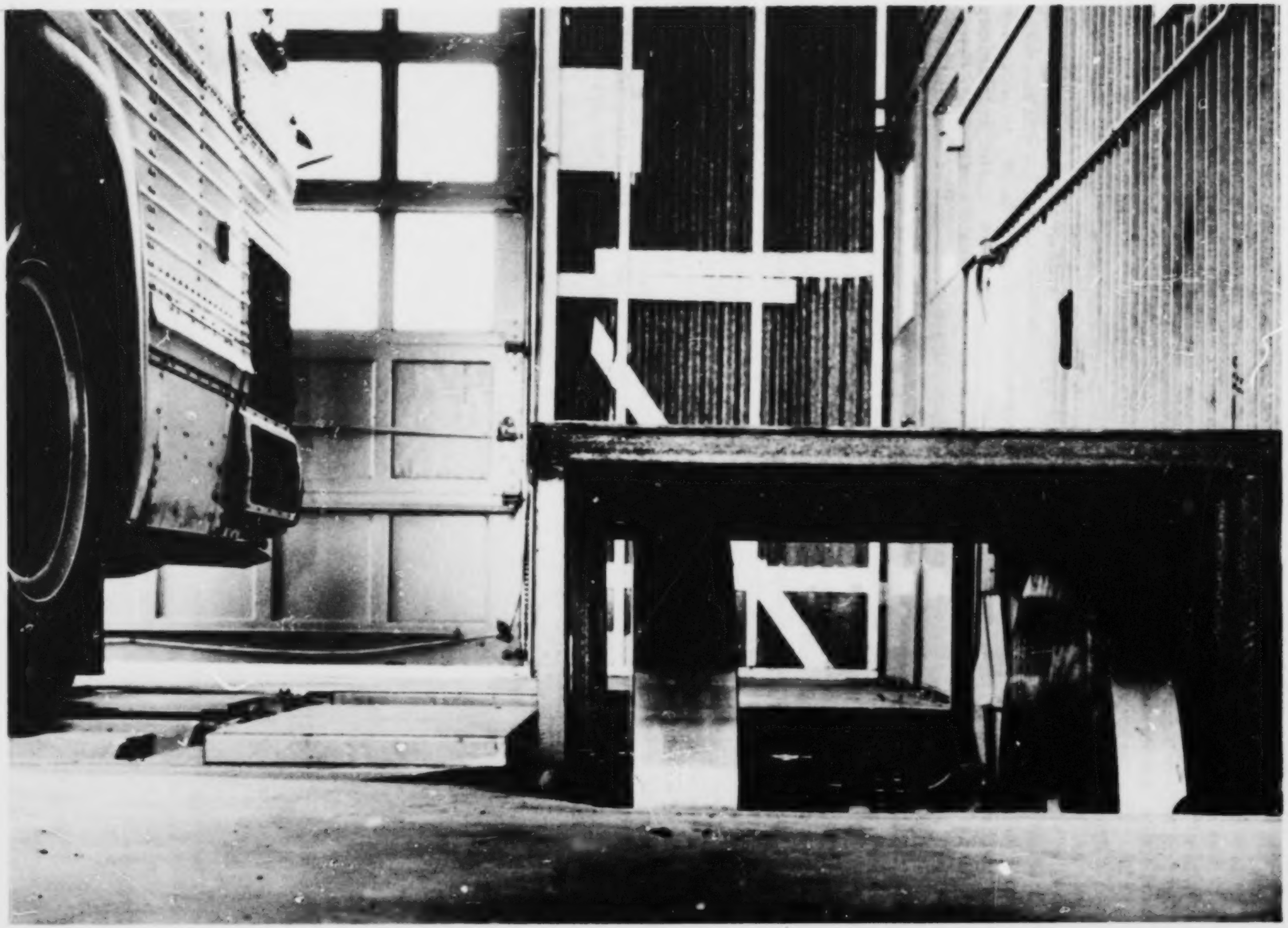


FIGURE 16. SPECIAL SwRI CHASSIS DYNAMOMETER AND VEHICLE INERTIA SIMULATION EQUIPMENT

IV. PROCEDURAL DEVELOPMENT

The objective of this portion of the program was to develop chassis dynamometer, odor, and smoke measurement procedures for diesel powered vehicles. During this development, the odor and smoke measurement facilities described in the previous section, Section III, Facility Development, were employed. The results from the field studies, described in Section II, permitted the proper choice of conditions and dilution levels for use during this procedural development step. The resultant procedures required for the study of vehicle variability, reported in Section V, also begin to set the precedent for future similar work and for evaluation of various odor and smoke control techniques, devices, additives, etc. The following subsections discuss the results of the procedural development studies with (1) a GM Truck and Coach Model 4519 municipal bus powered by a Detroit Diesel two-cycle, 6V-71, E Series, two-valve engine with the muffler located under the coach, and (2) the Ford cab-over tractor, tandem axle truck powered by a Cummins NH 220 naturally aspirated four-cycle engine with a R-910 Fuller 10-speed Road Ranger transmission and Eaton single speed rear axles.

A. Bus Procedural Development

The results of this portion of the vehicle procedural development phase are described in two subsections as (1) odor procedures, and (2) smoke procedures. All of the bus procedural development data are included in Appendix C*.

1. Odor Procedures

The development of suitable odor procedures was commenced after the odor panel had completed several weeks of formal and transition training from Q/I kits to actual dilute diesel exhaust. This preliminary training was previously reported in Section III. The procedural development work was begun by conducting a number of experimental series with the objectives of: (1) increasing each panelist's confidence in her ability to evaluate dilute samples of diesel exhaust, (2) improving the overall panel results, (3) developing workable, practical, yet realistic dynamometer procedures, (4) investigation of significance in vehicle operation and dilution levels, and (5) determination of whether the panel could distinguish differences in operating conditions and dilution, their level of success, and relation to the small panel road odor data. Listed on Table 1 of Appendix C are the twenty-five series of procedural development experiments conducted. These experiments, comprising over twenty-five working days and covering six work weeks, were sucessful in meeting the five objectives mentioned above.

The first five experimental series listed in Table 1 of Appendix C were exploratory in nature and were devoted to phase-out of the formal training with the quality/intensity kit and phase-in of dilute diesel exhaust. A variety of constant-speed and idle-acceleration conditions at various loads and dilution levels were cursorily investigated. Due to the nature of these experiments, the detailed data and results are not reported. It should be mentioned, however, that these preliminary trials did indicate that the diesel exhaust sample dynamically diluted and simultaneously presented was apparently the same overall as one would experience in the field. In addition to sample realism, it was found that the panel could experience a change in dilution within 2 to 3 seconds after the change was effected.

The temperature, humidity, particulate, and odor-controlled odor room panel environment was satisfactory. The fume removal devices positioned over each presentation cone apparently did an excellent job of removing the unwanted diesel exhaust between panel exposures. This was determined by the complete lack of diesel exhaust smell in the odor room after long periods of routine operation.

Following the refinement and close calibration and adjustment of the dilution system, previously described in Section III, a series of twenty procedural development experimental series was conducted. These series, each requiring one work day to perform, are listed in Table 1 of Appendix C. The results of each of these series were reduced and summarized and are included in tabular form in Appendix C. Before discussing the results of these experiments, it may be helpful to explain the general dynamometer odor panel procedure followed and the data reduction system employed.

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*All of the tables called out in this section, "IV.A. Bus Procedural Development," are presented in Appendix C.

Although the majority of the procedural changes occurred during the first five series, refinement continued at a decreasing rate through Series 9. The refinements and modifications made during runs 5 through 9 generally were minor in nature. Beginning with Series 10 and continuing through Series 20, the dynamometer and odor panel procedure were in accord with those described in Tables 1A, 1B, and 1C of Appendix C. These three tables present tentative operating procedures which include the following:

	Speed, mph	Power, hp	Power Level
Constant Speed	20	40	near maximum rack
	30	40	2/3 power
	40	40	2/3 power
Idle-Acceleration	0-35	30 at 30 mph	open rack
Constant Speed Deceleration	40-0	40 at 40 mph	closed rack

A detailed description of the constant speed procedures employed is contained in Table 1A for the 20, 30, and 40-mph steady state operation. The selection of 40-hp vehicle output at 20, 30, and 40 mph was intended to: (1) simulate somewhat the normal field sustained or steady state cruise condition; and (2) obtain a range of the various qualities. These power levels were also selected to permit procedural development with minimum tire maintenance (three tires were ruined, and three tires were changed for preventive maintenance during the course of procedural development).

The 1-minute idle followed by full-rack acceleration with vehicle inertia simulation and power absorption (water-brake dynamometer preset to 30 hp at 30 mph and retained) procedures are contained in Table 1B. Table 1C gives a description of the constant speed-deceleration procedure as used in the laboratory. The underlying influence in the development of these tentative procedures was realism. It was desired to translate into the dynamometer laboratory the actual field conditions and to reproduce the field odor as closely as possible.

Table 1D is a representative data sheet used by each panelist to record the results of the quality/intensity evaluation of each sample of dilute diesel exhaust. Note the overall diesel "D" composite is the first rating heading followed by first most obvious, second most obvious, third most obvious, and fourth most obvious. This raw data sheet was designed to permit the panelist to place, in order of obviousness, the four quality standards of "B" Burnt-Smoky, "O" Oily, "A" Aromatic, and "P" Pungent. The number adjacent to the letters denotes the intensity rating of 0 to 4; 0 not apparent or detectable, and 4 strongest. The entire procedural development series with the bus was performed with the initially provided pungent intensity standards. It may be that the evaluation of the sample in terms of obviousness may help facilitate statistical weighting of the scores at a later date. Such data may allow a total condition score to be of the form: Total Condition Score = (v) "D" + (w) "B" + (x) "O" + (y) "A" + (z) "P" where v, w, x, y, and z are statistical weighting factors. It should be reported that the panelist always rated for the "D" overall diesel standard first. Of the four remaining qualities, the "B" Burnt-Smoky standard generally was most obvious, and the "P" Pungent standard was generally least or fourth most obvious. The "O" Oily and "A" Aromatic standards were generally found under the remaining two categories.

The results of the first fifteen series of experimental procedural development tests are contained in Appendix C. Each series is covered by a summary table and a group of supporting tables listing the panel responses. For example, Tables 2 through 2E are concerned with Series 5 Constant Speed results. Table 2 summarizes replicate runs at increasing dilutions without and with load, and indicates the average panel responses under these various load categories for each dilution level investigated. Tables 1A through 1E list the "D" composite, "B" Burnt-Smoky, "O" Oily, "A" Aromatic, and the "P" Pungent quality/intensity results, respectively. The remaining series are similarly reported. These five supporting tables are constructed by tabulating the individual panelist's sample evaluation scores. These tables illustrate the panel response distribution for each sample evaluated. The averages computed and listed on these supporting tables and on the summary table are simple arithmetic averages. For example, if the panel, for a particular condition, rated 2 responses as D5, 4 responses as D6, and 4 responses as D7, the computation would be 2 × 5 + 4 × 6 + 4 × 7 = 62/10 = 6.2. This simple data reduction method does not, however, include any weighting factors for intensity, obviousness, importance, or the fact that D5 is half as strong as D6 and D6 is half as strong as D7.

Series 6 through 8 were conducted under dilutions ranging from 200:1 to 800:1 and at vehicle loads of no load to 40 hp. Series 6 and 7, Tables 2 and 3, were at constant speed of 40 mph and 30 mph, respectively. It is interesting to note the complete lack of any odor reported in runs 1 and 2 of Series 6. These runs were made first thing on a Monday morning without the engine running. This was accomplished without the knowledge of the panel and illustrates that the dilution system, after extended usage, retained no noticeable odor. The Series 6 and 7 constant-speed data indicated that the panel could detect changes or differences in dilution level correctly; i.e., an increase in dilution resulted in a decreased "D" composite and "B" Burnt-Smoky panel response. A few transient idle-acceleration and deceleration runs were conducted during Series 7 and 8 (Tables 3 and 4) which will be reported on further in later series. One important conclusion was that the dilution range should extend from 100:1 to 1000:1, similar to that determined at reasonable positions behind and beside the bus in the field.

Accordingly, Series 9 and 10 were conducted at a 30-mph constant speed and 0 to 35 mph idle-acceleration, respectively, at 100:1, 500:1, and 1000:1 sample dilution ratios. As shown in Table 5, the difference between 100:1 and 1000:1 was dramatic--6.1 to 2.9 for overall diesel composite and 1.9 to 0.9 "B" Burnt for no load. The same trend, although not as dramatic, was indicated in Table 6 for the Series 10 transient conditions. In both series, the 500:1 dilution level responses appeared closer to the 1000:1 than the 100:1. To remedy this, an intermediate dilution of 300:1 was selected. For 100:1, 4 SCFM of sample was required. For 1000:1, 0.4 SCFM of sample was required. The intermediate dilution level of 300:1 required a sample of 1.33 SCFM of exhaust. The 1.33-SCFM sample was essentially three times the 0.4-SCFM sample and approximately one-third the 4-SCFM sample. This proportioning of the exhaust sample resulted, in consequent series, in the intermediate dilution response generally midway between the 100:1 and 1000:1 responses.

Series 11 through 15 (Tables 7 through 11, respectively) were concerned with establishing the effect of load, dilution level, etc., on the five operating conditions (three constant speed and two transient) previously mentioned. This group of tests was successful in demonstrating the relative importance of variations in load and especially variations in dilution level and tended to confirm the previously discussed series of experiments. The Series 11, 20-mph constant speed overall composite "D" at near maximum rack, was greater than the no load conditions at 100:1 and 300:1. This condition usually was characterized by a sickening-sweet smell which, on continued exposure, resulted in several of the panel members experiencing a nausea or ill feeling. Some of the panel members were more sensitive to this odor than others. The aromatic "A" quality results, however, do not necessarily reflect this sweetish-type sickening smell when compared to the aromatic results of the 30-mph constant speed (Series 15, Table 11) and 40-mph constant speed (Series 13, Table 9). The constant speed-deceleration conditions (Series 12, Table 8) resulted in a pronounced sour quality as evidenced by the relatively high levels of 1.1 "P" at 100:1 dilution. This sour-type smell was very similar to that detected by the small panel during the field studies. The "a," "b," and "c" exposure results do appear to indicate that about midway between "b" and "c" would be representative of the most significant odor condition. This was apparent from not only the 100:1 but the 300:1 and the 1000:1 dilutions for the "D," "B," and "P" results. The "O" and "A" responses seem to remain essentially constant during the decelerations. The idle-acceleration data of Series 14, Table 10, seem to indicate that of the three exposures during the acceleration after the 1-minute idle, the most significant was the "a" exposure 3 seconds after start of acceleration. This was true for the "D" standard with or without load at 100, 300, and 1000:1 dilutions. This trend may be seen for the "B" Burnt-Smoky quality at 300:1 and 1000:1.

The "a" exposure also seemed most significant for the "O," "A," and "P" qualities for practically all load conditions and dilution levels studied. In summary of Series 11 through 15, the most severe odor levels were measured at the strongest dilution under loaded conditions for steady state, as well as transient operation. The most significant condition during the idle-acceleration condition was "a," 3 seconds after acceleration, whereas the most noticeable odor for the constant speed-deceleration occurred at approximately 20 mph, between the "b" and "c" exposures.

The previously discussed data and results were all obtained with a constant mass sample of exhaust regardless of engine, vehicle, or load condition. This was accomplished by using three separate primary orifice plates, one for each dilution investigated. The sampling system also was capable of obtaining an exhaust sample proportional to engine speed which was essentially linear with engine exhaust gas flow. To explore the potential of proportional sampling, Series 16 and 17 were conducted under transient conditions. The results of the idle-acceleration, Series 16, and constant speed-deceleration, Series 17, runs are listed in Tables 12 and 13, respectively. These results indicate that proportional sampling was feasible. Regardless of the feasibility of obtaining a sample of exhaust proportional to engine speed, the overriding factor of panel exposure had to be considered. Panel practice was to take a sniff and make a judgment on this sniff. This was, as previously described, performed periodically during the acceleration or deceleration. To make proportional sampling useful, the panelist would have to expose herself continuously during the transient which lasted about 60 seconds. Continous exposure to samples of diesel exhaust should be avoided to prevent olfactory fatigue. During the early panel familiarization with diesel exhaust, continuous exposure was tried, and it resulted in confusion, frustration, and nausea in some cases. As a result, the panel was trained to make snap judgments with one periodic sniff. Experiments were made where the panelist was permitted to go back and reevaluate and change her rating. This resulted in worse panel performance than using one exposure and one judgment. When considered from the standpoint of how the panel rates a transient condition, it was apparent that proportional sampling was actually no better than constant sampling. From a practical standpoint, there were more chances for error in proportional sampling than in constant sampling and also more difficulty in determining the dilution ratio. Using point or periodic sniffing, it was uncertain that the dilution ratio, which was continuously changing with engine speed, could be accurately known when the sniff or exposure occurred. One technical problem existed during the start of full rack acceleration which may require further development. This was the problem of using a fixed orifice plate which, at idle, had a very low pressure drop, and then followed by an immediate surge of flow in the central stack. This surge was accompanied by pressure fluctuations apparently equal to the orifice pressure drop resulting in an unstable controller. This unstable condition persisted for 2 to 3 seconds despite normal instrument adjustment of reset and proportional band. With constant sampling, this problem does not occur, because each orifice plate is sized to give approximately a 3-inch pressure drop which was not materially affected by the initial pressure fluctuation. Although proportional sampling is not recommended for use with human panel measurement, this method of sampling may be invaluable for bag sampling or for use with a continuous monitoring instrument odor system.

The last three series, Series 18 through 20 (Tables 14 through 16), comprised mixed runs at random of the five (three steady-state and two transient) operating conditions. Since load appeared to have a consistent, though minor, increase in odor severity, all of these runs were with load and with constant sampling and dilution. The objective of the mixed conditions was to determine panel performance when a variety of operating conditions were used much as they would be if an additive, a device, or a vehicle were being evaluated. The panel, however, was alerted to transient runs because of the periodic exposure procedure. An analysis of the results indicated that the panel can operate successfully under the aforementioned procedures where the runs are not of the same type or necessarily repetitive. Good agreement on repeat or duplicate runs also was noted.

Representative operating data regarding the temperatures of the exhaust stack gas and the exhaust sample were obtained and are reported in Table 17 (Series 20, mixed conditions) and Table 18 (Series 17, constant speed-deceleration) of Appendix C. The sample temperatures, obtained by a 30-gage iron constantan bare element thermocouple and a 0 to 10-mv potentiometric strip chart recorder varied from a low of 126 to 393°F, 1 inch upstream of the primary flow orifice. The stack temperatures, obtained from the center of the central stack near the sample point, ranged from 270 to 570°F. The exhaust temperature at idle at this point, approximately

6 feet from the tip of the vehicle exhaust pipe, was generally around 225°F. Table 18 lists data for both constant and proportional sampling. Under constant sampling conditions, the sample gas temperature tended to flatten out and become stable during the run, whereas, with proportional sampling, the sample temperature varied with the flow rate due to heat transfer to the surroundings.

The tentative odor procedures developed as previously described herein were discussed at a meeting on December 6, 1966, with the Project Officer, Ralph Stahman, along with Andrew Rose, George Kittredge, Howe Hopkins, and Don Hill of the U. S. Public Health Service. This meeting was held at the National Center for Air Pollution Control in Cincinnati, Ohio. It was pointed out that none of the above tentative odor producing conditions had been found to be as severe as that caused by a cold two-cycle engine at idle. This condition, explored earlier by the ten-person odor panel, resulted in several panelists becoming nauseous and ill. The remainder of the panel also complained of the rank and foul odor produced under this cold-engine start-idle condition. Because of this, the difficulty of defining a suitable idle engine operating condition, and, because the cold idle is not a normally experienced operating condition, little further development of the idle was considered. On the advice of the Project Officer, it was mutually agreed that a hot-engine idle should be explored to determine if a procedure could be satisfactorily developed. Such an idle condition should be indicative of a condition which might be routinely experienced by pedestrians or motorists.

Listed in Appendix C are the results of the development of a hot-idle, two-cycle powered bus exhaust odor evaluation procedure. The tentative operating procedure is described in Table 22 of Appendix C. The dynamometer procedure was designed to simulate constant speed 30-mph bus operation at 40 hp, followed by a closed rack deceleration under full inertia simulation to downshift at which time engine idle begins. This condition, like the idle-acceleration condition, is similar to one which is repetitively experienced during routine urban and residential-type "stop-and-go" bus driving. Table 23 summarizes the odor panel responses for repetitive hot-idle, two-cycle bus conditions. This table lists the results at increasing dilutions of 100, 300, and 1000:1 following no-load and loaded 30-mph operation. Although the intensities indicate the hot-idle odor to be significant, only a few complaints by the panelists were noted. The reason for this may have been that, in addition to the hot-idle condition being less severe than the cold idle, the panelists had all been trained to rate the dilute exhaust sample on the basis of two or three sniffs during a 50 to 70-second period and not to prolong their exposure. Tables 23A, B, C, D, and E list the panel response distribution for the "D" overall composite, "B" Burnt-Smoky, "O" Oily, "A" Aromatic-Aldehydic, and "P" Pungent quality standards. The earlier reported effect of increased dilution on panel ratings of intensity were experienced during this series of experiments. As a result of the satisfactory development of this new dynamometer-panel procedure, the hot-idle operating condition was considered for use in the bus variability study.

Series 22 and 23 (Tables 24 and 25, respectively) should be considered together as they represent two days of similar mixed condition panel operation. The intent of these two series of experiments was to integrate the hot-idle condition with the other four bus variability operating conditions, begin panel transition from procedural development to variability-type evaluations, and complete the Phase C procedural development work. The supporting tables, Tables 24A through E and 25A through E, list the panel responses and their distributions for each of the five quality standards. The effect of dilution was significant on the "D" overall composite and each of the four quality standards, as shown on the summary tables, Tables 24 and 25.

Comparing the Series 22 and 23 mixed-condition experiments with the four-cycle diesel engine powered truck-tractor, evaluated the previous week, indicates that the quality/intensity kit apparently did show differences between the one bus and one truck studied. This is evident in the "D" composite ratings and especially in the increased burnt-smoky and oily responses for the bus relative to the truck. More work needs to be done, however, before these differences can be confirmed and formally reported. The vehicle variability studies may be helpful in this regard.

In preparation for the ten-bus variability study, Series 24 and 25, comprised of mixed conditions, were conducted. These evaluations, all at a 100:1 dilution ratio, are reported in Tables 26 and 26A through E (Series 24) and Tables 27 and 27A through E (Series 25). Considering these two series together, it may be seen that repeatability during each daily series and from

Series 24 to Series 25 appeared satisfactory. In completing the transition of the panel from procedural development to constant 100:1 dilution, numerous "blanks" were evaluated by the panel. The "blank" runs served the double purpose of giving the panelists a break from the generally intense exhaust odors experienced at 100:1 dilution and to ascertain the amount of odor hang-up in the dilution and presentation system. These runs, conducted in random order, were performed the same as other runs except with a solid or "blank" orifice placed in the sample system. With the "blank" orifice installed, only the charcoal and particulate filtered air was circulated through the system. The results of the "blank" runs are listed separately at the end of Tables 26 and 27 and indicate that a minimal level of residual odor was experienced by the panel. The overall result of the two days of operation indicated that the five odor conditions at 100:1 dilution could be satisfactorily employed during the variability study.

In summarizing these procedural development experimental series, it may be reported that the PHS-SwRI odor panel was successfully trained to judge and evaluate dilute samples of diesel exhaust using the quality/intensity kit. Additionally, tentative operating procedures were developed and investigated. Trends of the results and simplifications to the procedures were discussed and recommended.

2. Smoke Procedures

Smoke measurement procedures were developed for use with the U. S. Public Health Service full-flow light extinction type smokemeter. This instrument, previously described in Section III, permitted continuous measurement of the light obscuration of the visible smoke plume.

As pointed out in Section II, Field Studies, the geometry of the bus exhaust pipe may have a significant effect, not only in the atmospheric dilution but also on the visibility of the plume of smoke. To adapt the PHS smokemeter to the many and varied types of bus exhaust pipes, extensions, and deflectors would be difficult and in some cases practically impossible. For example, the currently produced, widely used city bus employs a sweep ell directed down and sliced horizontally as the exhaust tip or deflector. To use the PHS meter on such a geometry would not be feasible. Therefore, for the slightly older units, which have an oval horizontal exhaust configuration, an adapter which would return the exhaust back to the stack's 3-inch round configuration was required.

The oval adapter and 3-inch round extension designed and fabricated for use in this program are shown in Figure 17. The PHS smokemeter was mounted horizontally by means of a 3-inch to 4-inch aluminum sleeve. The extension pipe and meter arrangement was supported by a suitable stand. The extension and half-sweep elbow, from a new GM bus exhaust pipe, was the exact diameter of the usual exhaust pipe. The half elbow was required to direct the bus exhaust out the large overhead door of the building rather than allow it to recirculate within the building. The prototype smokemeter readout instrument and the potentiometric strip chart recorder employed in the smoke studies are shown in the background. This system worked satisfactorily in the SwRI studies of city bus smoke under a variety of conditions.

Some of the initial exploratory measurements obtained with the PHS smokemeter are shown in Table 19 of Appendix C. These constant-speed measurements defined the band of smoke to be expected under steady state engine and vehicle operation throughout the low and drive vehicle transmission ranges. It should be noted that the bus tested, operating on a No. 1 fuel, did not have a high level of exhaust smoke. The highest level recorded was 10 percent which occurred with the engine at maximum power at relatively low engine speeds during 20, 25, and 30-mph vehicle operation in the drive range of the transmission. Engine upshift occurred at 26 or 27 mph and downshift occurred at 16 to 17 mph under normal operation. Sustained cruise maximum power operation at 20 mph in drive range would occur up a long grade or under similar circumstances. None of the other constant speed conditions appeared significant, and this confirmed the small panel road results previously reported.

To investigate the effect of load on those significant drive range smoke-producing conditions, a series of measurements was obtained at various part rack, part power levels. These results, listed in Table 20, show that the smoke levels remained low until the last 5 to 15 hp of the

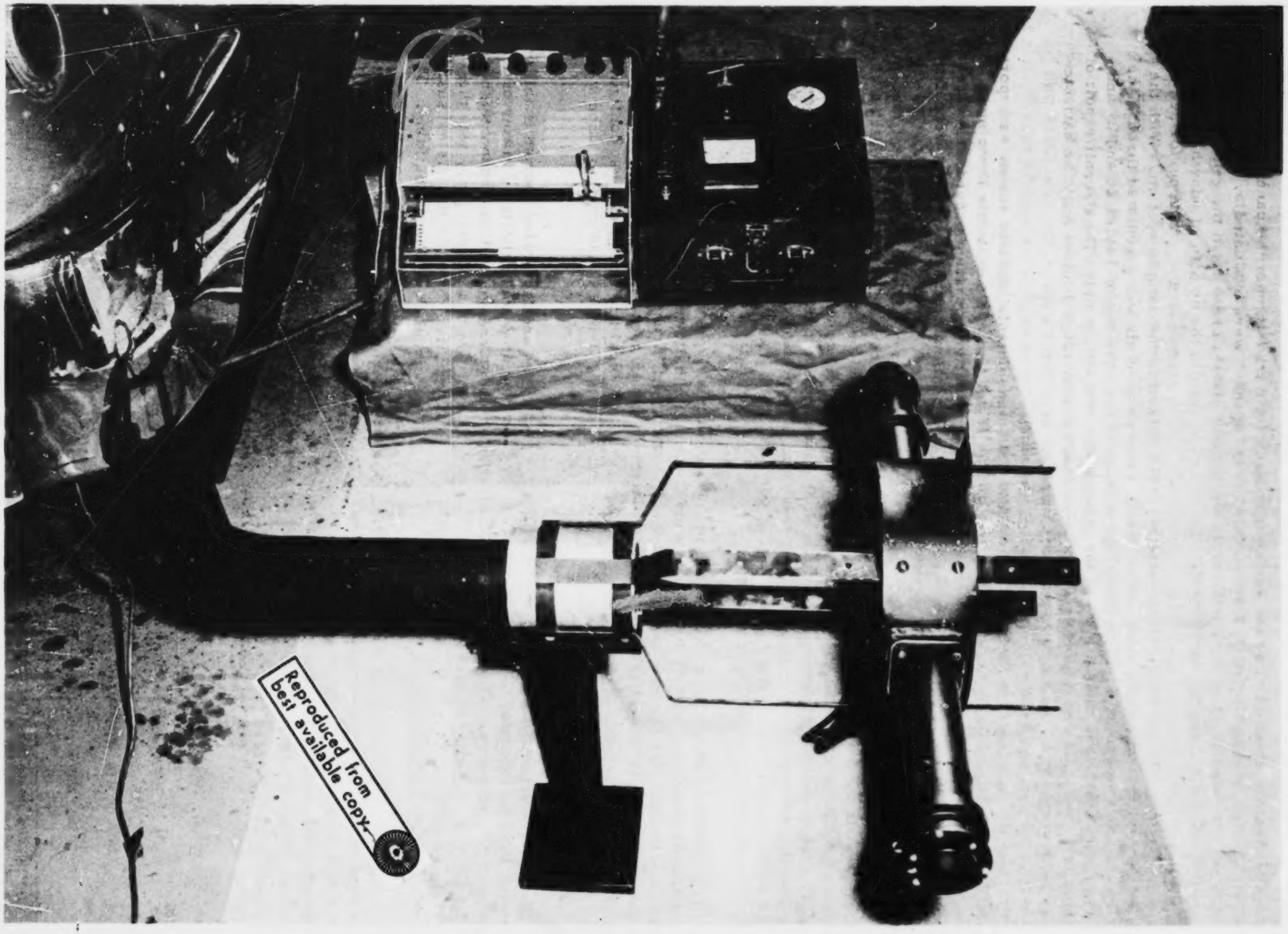

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FIGURE 17. U. S. PUBLIC HEALTH SERVICE SMOKEMETER MOUNTED ON EXTENDED G.M. MUNICIPAL BUS EXHAUST PIPE

vehicle were obtained at which time the smoke increased from 2 or 3.5 percent up to 9 to 12 percent at 20, 25, and 30 mph (the most significant constant speed smoke conditions). As the higher engine speeds are attained at 35 mph and above, the smoke levels decreased for comparable engine rack position and did not appear significant.

Smoke data for correlation purposes were obtained using a British Petroleum Hartridge light extinction smokemeter under steady state conditions. These data are listed on Tables 19 and 20 of Appendix C. The Hartridge measured the smoke intensity of a sample of the vehicle exhaust rather than the full flow of the exhaust and was not as revealing nor as versatile as the PHS meter. By means of the 0 to 100-mv strip chart potentiometric recorder, the PHS instrument has been shown to be sensitive to extreme transient conditions such as the first black puff on engine start, the surge of black-blue smoke after sustained idle on engine, or vehicle acceleration and upshift and downshift. The continuous record of the smoke density permits analysis of instantaneous changes, etc., as they occur. This type of data is not currently available from sampling-type smokemeters. Numerous idle-acceleration-constant speed-deceleration conditions with various loads impressed in the dynamometer were investigated. The results are shown in Table 21 for the most significant smoke levels during the entire cycle of engine start, idle, full rack acceleration, constant speed, closed rack deceleration. The first black puff on engine start consistently resulted in the greatest smoke intensity of 24 to 34 percent, although it was only momentary. Start of the acceleration after the 1-minute idle rated between 7 and 16.5 percent. Upshift was the most significant smoke-producing condition encountered during this transient cycle, ranging from 8 to 11.5 percent. The upshift smoke, however, was much more sustained and prolonged than the engine start and the initial acceleration or engine clearing condition. These measurements also tended to confirm the small panel data. Figures 1 and 2 of Appendix C show typical PHS smoke measurement traces made during the transient cycle runs.

Summarizing the smoke measurement procedural development effort, it appears that constant speeds of 20, 25, and 30 mph (drive range) at maximum power should be utilized. In addition, a 1-minute idle followed by a full rack acceleration up through upshift is warranted in which the continuous record is evaluated for its maximum smoke level(s) at the start of acceleration and on upshift.

B. Truck Procedural Development

Similar to the municipal bus procedural development, the development of measurement procedures for the truck-tractor is discussed under the following subheadings of (1) Odor Procedures, and (2) Smoke Procedures. The data and results from the truck-tractor studies are included in Appendix D*.

1. Odor Procedures

The development of the truck-tractor odor procedures was conducted after most of the bus procedure study was complete. A series of twelve experiments was required to obtain adequate data for analysis. Before discussing these data, it should be helpful to explain the general dynamometer-odor panel procedure followed and the data reduction system employed. Considered during this procedural development were operating parameters of:

(1) Exhaust Dilution Ratio--500:1 to 7000:1;

(2) Engine Speed--1400 to 2300 rpm;

(3) Vehicle Speed--0 to 70 mph;

(4) Transmission Range--1 to 10 forward gears;

(5) Vehicle Output--0 to 160 hp, maximum power; and

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*All of the tables called out in this section, "IV.B. Bus Procedural Development," are presented in Appendix D.

(6) Modes--constant speed, idle, idle-acceleration, acceleration and constant speed-deceleration.

Tables 1A through 1E, Appendix D, describe the five basic evaluation procedures used for determination of the quality and intensity of dilute truck-tractor exhaust. All of the twelve experimental series listed in Table 1 utilized these procedures or a slightly modified version, as indicated by footnotes. The procedures used included the following types of operation:

Condition	Vehicle Speed, mph	Engine Speed, rpm	Power, hp	Power Level
Constant speed	26	1700	150	Near max
	29	1900	150	Near max
	33	2100	150	Near max
Idle	--	575	0	0
Idle-acceleration	0-8	575-2300	0	0
Acceleration	43-53	1500-2200	60 at 43 mph	Part
Constant speed-deceleration	52-0	2100-575	160	Near max

A detailed description of the constant speed procedures employed is contained in Table 1A for the 26, 29 and 33-mph operation in 7th gear at 1700, 1900 and 2100-rpm engine speed, respectively. The 150-hp condition was selected to provide test repeatability at approximately 10 hp below maximum conditions. The use of the 7th gear in the Fuller 10-speed transmission resulted in moderate vehicle speeds and stable dynamometer operation. Recommended truck engine speeds generally range between 1700 to 2100 rpm, although some tractors show a 1500 to 2300-rpm range.

An additional steady state procedure, an idle speed condition, was developed and employed. This procedure, described in Table 1B, requires the idle to be preceded by a 1-minute high engine heat condition of 150 hp at 1900-rpm engine speed. A closed rack deceleration of a few seconds duration was then permitted before the transmission was shifted to neutral and the engine allowed to idle. Panel exposure was begun 30 seconds after the engine idle began. Engine idle produces combustion conditions that are unstable and difficult to define. It is for this reason that the idle follows the high heat operation. Although the combustion chamber cools down during the idle period, this procedure should cause the cooling event to occur more repeatably than when attempting to stabilize at constant temperatures.

Table 1C lists the idle-acceleration procedure used during this truck-tractor procedural development phase. A 1-minute idle period followed by acceleration in 1st gear of a truck-tractor was necessarily a quick transient. The acceleration from 575 to 2300 rpm required 8 seconds under the SwRI 32,000-pound equivalent truck (16,000-pound axle) weight inertia simulation system. It should be remarked that normal tractor-trailer operation, under road conditions and similar gross weights, involves engaging the clutch at little or no power or rack until the tractor is just beginning to move forward, at which time additional rack and power is applied by the driver. Because of the large amount of rear axle torque, an abrupt acceleration in 1st gear is not normal practice. Following normal driving procedure, it was found that the engine speed would reach 1500 rpm, the point of exposure, 3 seconds after the rear wheels were allowed to rotate. Acceptable vehicle-dynamometer performance resulted with only an occasional momentary slip of one pair of the eight 10.00 × 20 tires. During this and all other dynamometer procedures, the interaxle differential was operated in the locked "in" position. This made the two axles pull and operate together and simplified loading of each axle. The inertia simulation system was balanced, however, and permitted operation of both driving axles within 3 mph of each other throughout the 0 to 60-mph speed range.

An acceleration procedure, shown in Table 1D, was developed to investigate the odor during a prolonged acceleration in 9th gear from 43 mph (1500 rpm) up to 53 mph (2200 rpm). This acceleration employed the SwRI 32,000-pound vehicle weight inertia system and was performed with 60 hp having been initally preset (impressed) into the water brake dynamometer. This acceleration occurred after a normal upshift from 8th gear and represents one portion of the typical and repetitive upshift operation of diesel powered trucks. Another, less typical, but possibly important operating condition is full or near open rack, maximum power, high speed operation followed by a closed rack deceleration in gear with inertia simulation under highly loaded conditions. A tentative constant speed-deceleration procedure is described in Table 1E of Appendix D. The tractor was operated in 9th gear at an engine speed of 2100 rpm, vehicle speed 52 mph, and 160 hp for 1-minute followed by a closed rack deceleration with exposure 5 seconds after start of deceleration. This and the other transient and constant speed conditions described were developed to translate into the dynamometer laboratory the road and highway conditions and reproduce the field situation as closely as possible.

Panel procedures and data reduction were essentially the same as those used in the previously reported bus procedural development studies. The panelist was still asked to rate the "D" diesel composite first and then to rate, on the basis of obviousness, the four quality standards. Whereas practically all bus ratings showed the "B" Burnt-Smoky quality most obvious and closely related to the "D" composite, this was not the case with the four-cycle diesel powered truck-tractor. Although the "B" quality was most obvious in a majority of cases, it generally was found to a lesser extent. In place of the "B" Burnt-Smoky quality, the "O" Oily and sometimes "A" Aromatic qualities were reported as most obvious. The "P" Pungent quality standard, including the new "P-1" provided by Dr. Amos Turk, was usually the least obvious. The results of the twelve series of experimental procedural development tests are contained in Appendix D. As in Appendix C, each series is covered by a summary table and a group of supporting tables listing the panel responses. For example, Tables 2 through 2E are concerned with Series 1 constant speed results. Table 2 summarizes replicate runs at increasing dilutions without and with load and indicate the average panel responses for each of the five quality/intensity ratings for each load and each dilution level investigated. Another parameter, engine speed, was linked to the vehicle speed by the drive gear and is explained in the appropriate footnote. Tables 2A through 2E list the "D" composite, "B" Burnt-Smoky, "O" Oily, "A" Aromatic-Aldehydic, and "P" Pungent quality/intensity results, respectively, and indicate the panel response distribution. The computation of the average score and other remarks regarding the design of these supporting tables were described under the bus odor procedural developments.

Series 1 through 4, reported in Tables 2 through 5, were intended to explore several of the numerous constant speed transient operating conditions of potential interest. Series 1, Table 2, was concerned with familiarization of the odor panel with the dilute diesel exhaust from the four-cycle powered truck-tractor. It should be reported that the odor panel found these dilute truck exhaust samples to be much more difficult to rate than those from the city bus previously investigated. The panel found that the four-cycle Cummins, NH 220, diesel exhaust samples were not only weaker but significantly milder, less penetrating and lasting, and more difficult to evaluate. More intense concentration was required, and the standards had to be referred to more often with the milder dilute exhaust. A wider range of panel response was also initially obtained requiring some retraining and familiarization. This was accomplished during the first four series of experiments, and it was for the purpose of gradual transition that the dilution levels of 500:1 to 5000:1 were used. The Series 1 tests were all under constant speed, 1700-rpm, 20-mph, 6th gear conditions with the load and dilution ratios varied between 0 and 120 hp at 500:1, 2000:1, and 5000:1 dilution levels. Only constant sampling, i.e., withdrawal of a constant mass flow of exhaust regardless of engine speed, etc., was utilized throughout this entire series of experiments.

Successful development of a test/evaluation procedure depended on many factors such as realism, fidelity, simplicity, practicability, and particularly on the ability of the panel to discriminate. In this case as with the bus, it was important to determine if the panel and dynamometer procedures could discriminate between dilution ratios, engine load, engine speed, and operating mode or conditions. As a result of the first series, there was no doubt that the panel noticed a substantial difference in the four-cycle engine exhaust as compared with the two-cycle engine. Moreover, the panel could experience and correctly rate changes in dilution ratio. According to Table 2, the panel results indicate that an increasing dilution ratio resulted in a lower or weaker "D" composite and "B" Burnt-Smoky. This was, of course, well established during the bus studies. Also, the panel could apparently discriminate between engine power conditions, possibly a more subtle and not quite so obvious change.

To further establish these preliminary trends and determine the range of effect various engine and vehicle speeds and loads exerted on the panel evaluation, Series 2 through 4 were conducted; all were constant speed except for Series 4; Series 2, Table 3, was conducted at 37 mph in 8th gear at an engine speed of 1700 rpm. The engine was operated to produce 0 to 150 and 160 hp (open rack). Duplicate runs were made at random of 500, 2000 and 5000:1 dilution levels. From Table 3, it is apparent that the panel response was sensitive to change in dilution ratio and power levels, particularly at the 500:1 dilution level. The ability to subjectively evaluate odors became increasingly difficult as the dilution was increased and the strength of the exhaust sample decreased. Table 4 reports the results of Series 3 constant speed conditions which substantiate the results of Series 2 (Table 3) and Series 1 (Table 2). The constant speed operating parameters explored in Series 3 were 24 mph in 7th gear, 1500-rpm engine speed, and 42 mph in 8th gear at 2100-rpm engine speed. The engine was operated under no load and open rack maximum power conditions at 500, 2000 and 5000:1 dilutions.

Series 4, Table 5, was concerned with transient conditions of sustained idle followed by acceleration in 1st gear and an acceleration in 9th gear after 8th gear operation. Both accelerations were conducted against inertia and load as specified in Tables 1C and 1D of Appendix D. Replicate runs were made of the idle-acceleration condition at 500, 2000 and 5000:1 dilution ratios with exposure occurring 3 seconds after start of acceleration (1500-rpm engine speed and 5.5-mph vehicle speed). These runs were conducted with no impressed load in the dynamometer. This was similar to typical truck operation, since generally only inertia has to be overcome at very low speeds. For this reason, the water brake dynamometer, which loads along a "q" curve similar to vehicle load (hp) versus vehicle speed, was particularly useful in this type of work. The results of these idle-acceleration runs showed relatively significant "D" and "B" ratings at 2000:1 and 5000:1 dilutions. The last seven runs of this series were the initial exploratory runs of a sustained maximum power acceleration in 9th gear. The procedure followed was essentially identical to that described in Table 1D except the panel rated the acceleration odor at 3 seconds after upshift from 8th gear, start of acceleration, and on reaching peak engine speed, 2200 rpm at a 53-mph vehicle speed. This acceleration was made with 60 hp initially impressed at 43 mph in 8th gear and retained in the dynamometer throughout the acceleration. The results of these high speed accelerations indicated that the most significant odor was produced later in the acceleration possibly due to the increased power (fueling) and the higher engine speed.

Throughout the remaining series of procedural development experiments, a dilution ratio range of 700:1 to 7000:1 was used. The selection of this range of exhaust dilution was based on the field survey and trace gas study of exhaust dilution discussed in Section II. These studies indicated that vertical stack tractor-trailer truck vehicle exhaust would be diluted in the atmosphere from 700:1 to 7000:1 at reasonable points behind and beside the vehicle. Additional constant speed conditions were investigated during Series 5, Table 6, at 700, 2000 and 7000:1 dilution under no load and maximum load conditions. The first twelve runs were at 30 mph in 8th gear at 1500-rpm engine speed. The last twelve runs were in 7th gear at 33 mph at 2100-rpm engine speed. Except for a change toward weaker ratings, the results demonstrated essentially the Series 1, 2 and 3 trends previously discussed.

Listed on Table 7 are the results for experimental Series 6 for a constant speed followed by a closed rack deceleration. This procedure is similar to the constant speed-deceleration method employed with the city bus. The procedure followed was essentially the same as that listed in Table 1E except the panel was exposed three times during the deceleration in an attempt to determine the most significant odor producing portion of the deceleration. To do this, the panel was exposed at 5 seconds, 25 seconds and 45 seconds after start of the closed rack deceleration. Two different sets of initial conditions were investigated at 700, 2000 and 7000:1 dilutions. The first twelve runs were made following 1 minute of no load of open rack maximum power operation in 9th gear at 54 mph and 2200-rpm engine speed. The last twelve runs were made following 1 minute of no load operation at 35 mph in 9th gear at 1500-rpm engine speed. The results summarized in

Table 7 indicate that the most significant odor was produced after open rack maximum power operation at 54 mph, 2200-rpm engine speed, at 700:1 dilution. Overall "D" composite ratings averaged 4.7 at the 5-second exposure after closed rack deceleration from 35 mph and 1500 rpm. The 25-second and 45-second exposures were significantly less. The deceleration was under inertia simulation of 32,000 pounds of vehicle weight and with the initially impressed 130 or 140 hp retained in the dynamometer. It may be recalled that a similar deceleration was performed on Commerce Street and Culebra Road from high speed (50 mph) and open rack conditions past the small four-man panel. This was one of the few field conditions that produced slightly noticeable odor. The dynamometer conditions closely reproduced the field operating conditions.

Additional constant speed conditions were explored during experimental Series 7, and the results are listed on Table 8. The first twelve runs investigated a 25-mph condition in 6th gear at 2200-rpm engine speed at no load and 140 hp (maximum rack). The last twelve runs consisted of operating the vehicle at 21 mph in 7th gear at 1400-rpm engine speed at 0 load and 130 hp (open rack). These conditions of 2200 rpm and especially 1400 rpm are not the engine speeds normally used in highway operation. The 1400 rpm particularly reflected an engine underspeed condition and would not be typical. The results were interesting in that somewhat less odor, as measured by the overall "D" composite rating, was experienced at 1400 rpm than the previously reported 1500, 1700, 1900, 2100 and 2200-rpm constant speed ratings. Otherwise, this series further substantiates the previous remarks and constant speed results.

One last condition was explored, and that was the odor produced by an idling four-cycle diesel engine. As indicated in discussions of Table 1B, which describes the idle evaluation procedure, the idle is the most difficult to define and reproduce of all the conditions investigated. The results of the idle exposure 30 seconds after a 1-minute high heat engine condition of open rack in 8th gear at 1900 rpm, 37 mph, indicate that the 700:1 dilution "D" responses were more repeatable and had less spread than comparable idles after no load operation. The 2000:1 results also showed an improvement in the "D" response for the idle after a loaded condition. These positive and reasonably satisfactory results indicated that the idle condition might be successfully used if it followed a high heat condition.

On the completion of Series 1 through 8, it became apparent that there were many operating conditions capable of producing a measurable exhaust odor. This program was, however, concerned with identification and evaluation of the more significant diesel engine odor producing conditions. Accordingly, the various steady state and transient conditions and their respective odor quality/intensity ratings were reviewed and analyzed for the purpose of selecting the more significant odor producing conditions. The criteria used in this selection were the overall "D" rating and the "B," "O," and "A" rating. Giving the overall "D" response the greatest weight, this analysis resulted in the selection of the five conditions previously listed and described. Constant speed conditions of 1700 rpm, 1900 rpm and 2100 rpm in 7th gear (26, 29, and 33 mph, respectively) under near maximum engine power and engine idle, after sustained engine operation at maximum or near maximum power, appeared important. Transient conditions of idle-acceleration, acceleration in 9th gear and deceleration after a sustained maximum power condition also appeared important. Following this review and study of the data, the tentative operating procedures described in Tables 1A through 1E were prepared. These seven operating conditions, four steady state and three transient, were then refined and simplified for further use. This was accomplished by exposing the panel only once during each of the three transient conditions. In the case of the 9th gear acceleration from 43 to 53 mph, this occurred at 50 mph. The 5-second reading after closed rack deceleration resulted in the highest odor rating of the deceleration exposure points considered, and this exposure was adopted.

Series 9 through 12, Tables 10 through 13, were mixed experiments of the seven (four constant and three transient) operating conditions and procedures. Series 9, Table 10, was considered exploratory in nature and was intended to familiarize and train the panel and the dynamometer technician when every run was different. For the purpose of these four series, dilution ratios of 700:1 and 2000:1 were investigated in duplicate and only under loaded, engine stressing, conditions. Runs 1 through 3 were invalidated due to an unexpected weekend cold front preventing proper operation of the truck-tractor. Although the tractor and dynamometer were located within a heated high bay area of the building, safe practice required the front overhead door to be fully open during vehicle operation.

Series 10, 11, and 12, Tables 11, 12, and 13, respectively, involved twenty-eight runs each to permit duplication of each of the seven operating conditions at 700:1 and 2000:1 dilution. These results may be considered together, although they consumed three full working days. Each summary table shows the 1700 rpm at 700:1 and 2000:1 dilution, the 1900 rpm at 700:1 and 2000:1, and the 2100-rpm constant speed data. The idle data are presented next at the two dilution levels. Idle-acceleration is summarized next followed by the 9th gear acceleration and then the constant speed deceleration data at 700:1 and then 2000:1 dilution ratios. The results of these three days of work showed that the panel had reached the level of training, experience, and background to permit them to evaluate whatever condition was presented.

The panel accuracy, agreement, and repeatability generally were better at the 700:1 than at the 2000:1 dilution ratios. Even the day to day results for similar conditions run in different, randomly arranged, sequence showed generally satisfactory repeatability and in some cases unexpected good agreement. This was mostly evident at the 700:1 dilution level.

In summary of these twelve series of truck-tractor four-cycle diesel engine experimental procedural development series, the PHS-SwRI odor panel was trained to evaluate the quality and intensity of dilute four-cycle engine exhaust under various odor producing conditions. Of the several conditions studied, seven (four constant speed and three transient) were considered repetitively.

Representative operating data regarding the temperature of the exhaust stack gas and the exhaust sample were obtained and are reported in Table 14 for the mixed conditions of Series 11 and in Table 15 for the mixed conditions of Series 12 of Appendix D. The sample temperature, obtained by a 30-gage constantan bare element thermocouple and a 0 to 10-mv potentiometric strip chart recorder, varied from a low of 58°F to a high of 158°F, 1 inch upstream of the primary flow orifice. The low sample flows for 700:1 and especially the 2000:1 dilution levels resulted in a fairly long residence time within the sample probe. Only 0.2 SCFM of sample was required at 2000:1, and this low flow, coupled to the cooler than usual room conditions when these temperatures were monitored, explains the rather low sample temperatures.

The stack temperature, obtained from the center of the central stack near the sample point, ranged from 190°F to 860°F. These representative temperatures were determined by averaging the continous record during the period of panel analysis for steady state conditions or by averaging at the time of point exposures (original plus a repeat) by the panel. The lower temperatures were obtained during the idle condition. All tractor four-cycle engine procedural development experiments were conducted under the constant mass or SCFM sampling method. For comparison purposes, the bus exhaust sample temperatures ranged from 126 to 393°F, and the stack temperatures varied from 225 to 570°F.

2. Smoke Procedures

As in the municipal bus smoke measurement procedure study, the U. S. Public Health Service smokemeter was exclusively used in developing suitable truck-tractor smoke procedures. Figure 18 shows a rear view of the tandem axle drive Ford cab-over tractor powered by a Cummins NH 220 naturally aspirated engine. The drive train consisted of a Fuller RT9-10 10-speed Road Ranger transmission and Eaton single speed rear axles. For ease and simplicity in loading, the interaxle differential was operated in the locked "in" position. The PHS full flow light-extinction type smokemeter, shown in Figure 18, was mounted on the 4-inch diameter vertical stack. The light beam was located 5-1/2 inches above the tip of the exhaust stack. The muffler-silencer for this Ford tractor was located between the saddle tanks. Note also the chimney above the smokemeter which permitted the escape of the exhaust and smoke from the dynamometer bay. The horizontal pipe located above the "5th wheel" was used to duct the exhaust from the outlet of the muffler over to the central exhaust stack, a distance of 22 feet, for sampling, dilution, and evaluation by the odor panel. Figure 19 is a front view of the truck-tractor. Figure 20 is a side view which

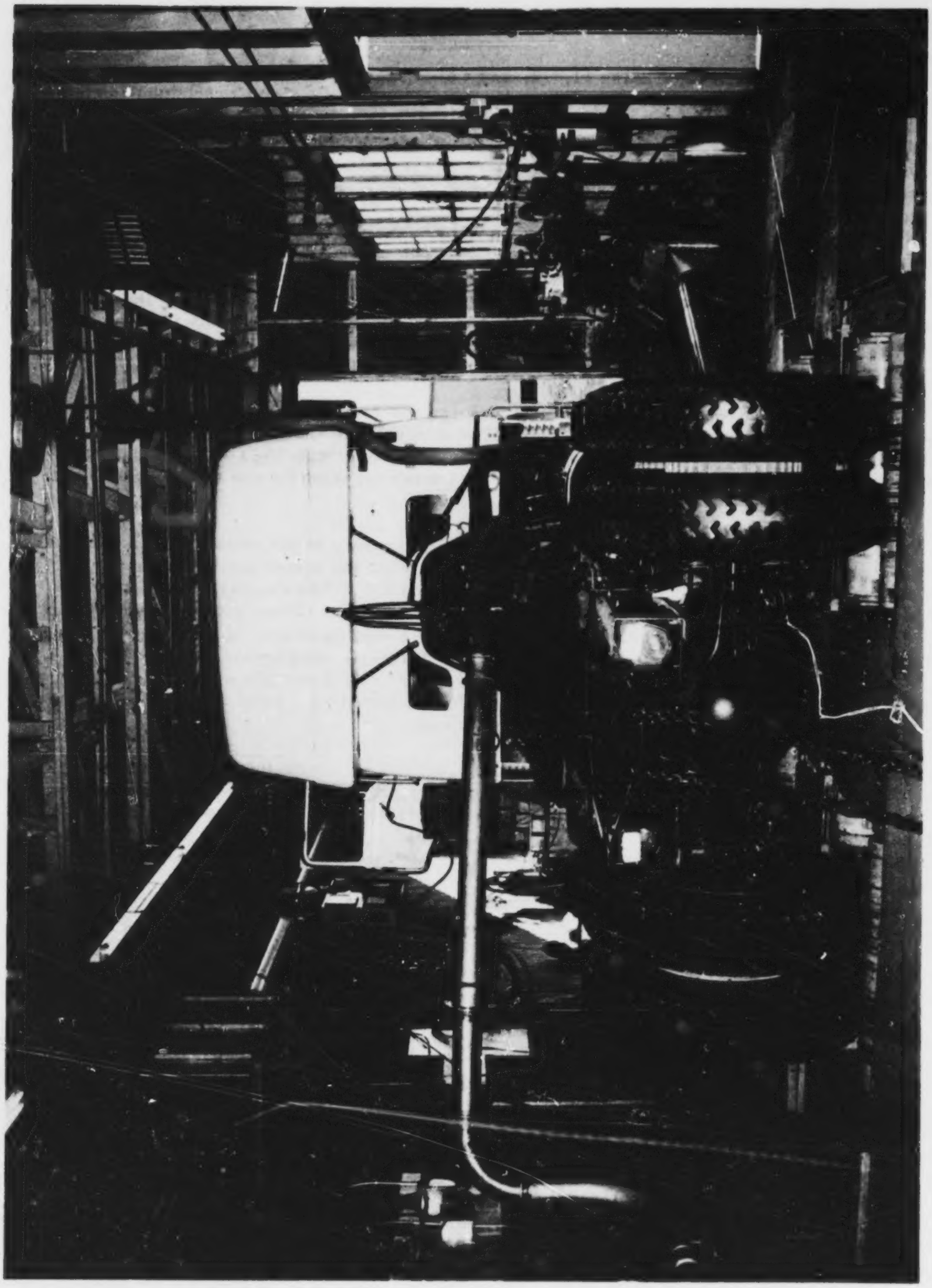

FIGURE 18. TRUCK-TRACTOR PREPARED FOR SMOKE EVALUATIONS WITH U. S. PHS SMOKEMETER MOUNTED
(Rear View)

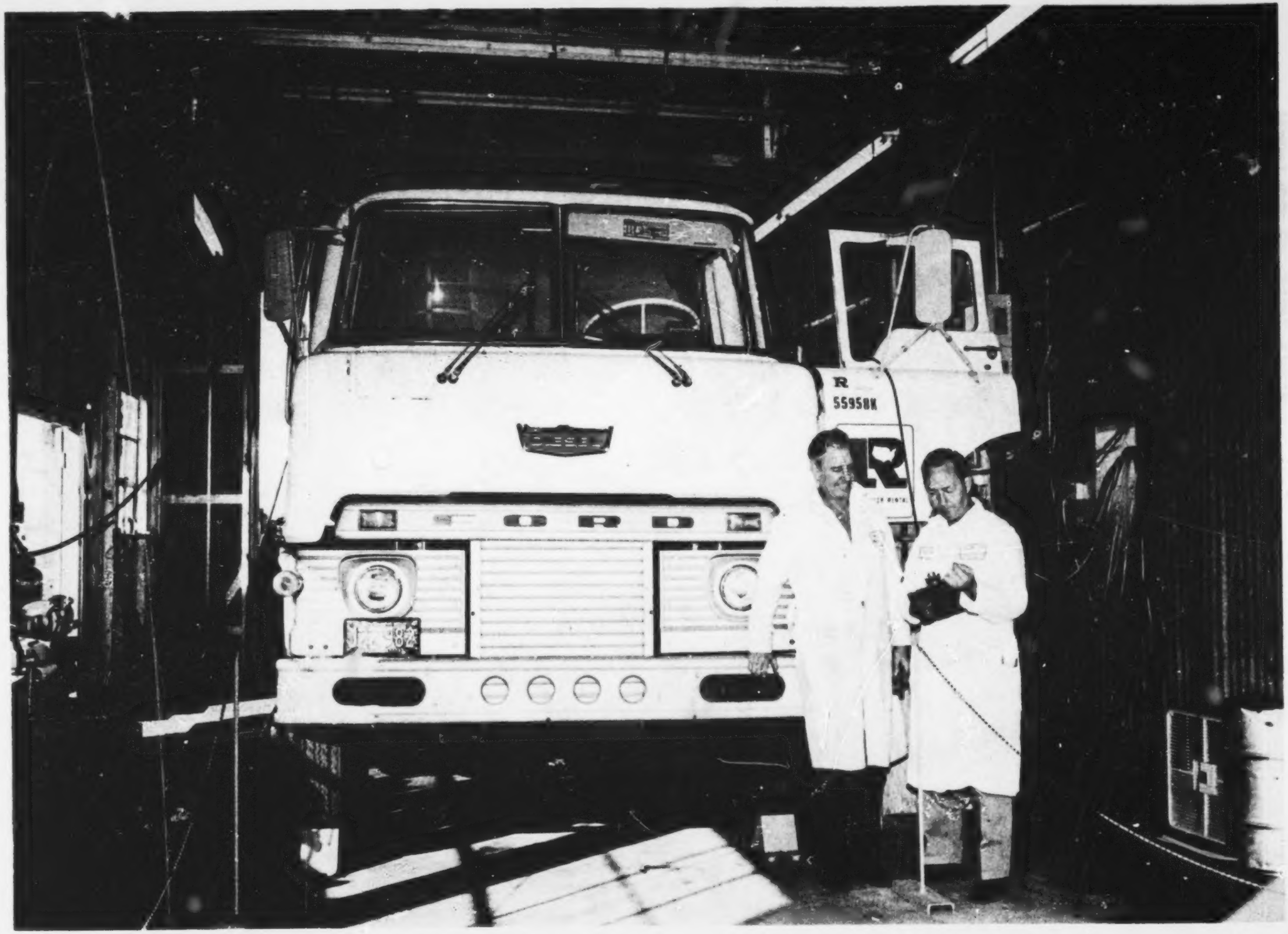

FIGURE 19. TRUCK-TRACTOR PREPARED FOR SMOKE EVALUATIONS WITH U. S. PHS SMOKEMETER MOUNTED
(Front View)

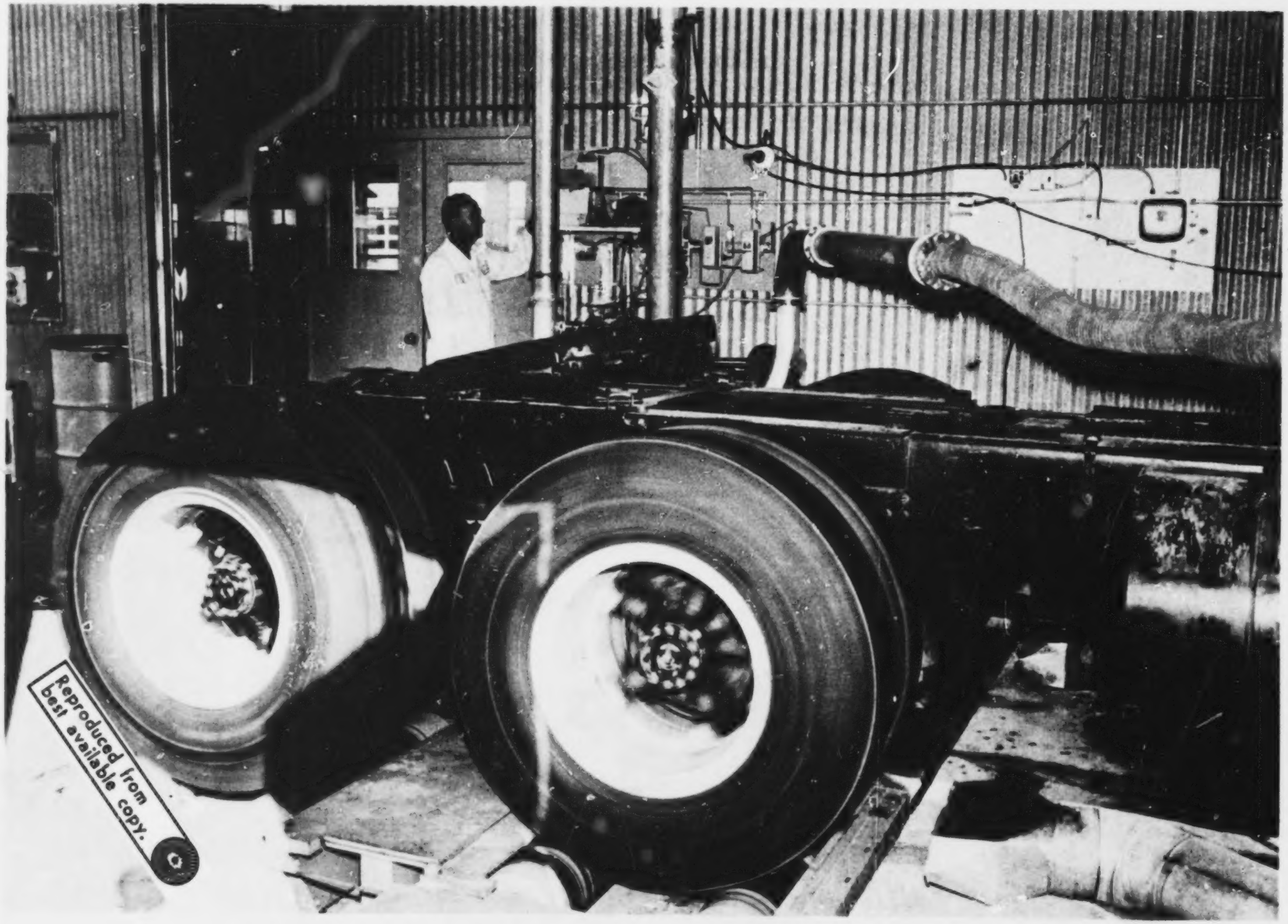

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FIGURE 20. TRUCK-TRACTOR UNDER TEST ON SwRI TANDEM AXLE CHASSIS DYNAMOMETER (Side View)

illustrates the tractor drive axles on the chassis dynamometer. In the background may be seen the electropneumatic automatic exhaust sample system and dilution equipment.

The initial use of the PHS smokemeter on the 4-inch diameter truck-tractor exhaust stack was to measure the smoke from the Cummins NH 220 powered Ford cab-over tractor. Both constant speed and transient vehicle/engine operation were explored. The results of some of these initial and exploratory constant speed smoke measurements are contained in Table 16. All of these measurements were made at 1700-rpm engine speed at near maximum power output conditions. Smoke data for correlation purposes were obtained using a British Petroleum Hartridge light-extinction smokemeter. The Hartridge sample was obtained by inserting a probe into the end of the exhaust stack and reading the resulting smoke level in terms of Hartridge units. The results of these initial tests indicated that the PHS smokemeter and the Hartridge instrument response may be related.

As part of the limited exploratory smoke studies, 5 gallons of reference number 2 diesel fuel was treated with Lubrication Engineers (Ft. Worth, Texas) Diesel Combustion Improver (DCI), a barium containing combustion improver and smoke suppressant. The treatment level was 1 gallon of DCI per 100 gallons of number 2 fuel, the maximum dosage recommended. Average treatment level was reported to be 1 gallon per 150 gallons of fuel. As shown in Table 17, the use of the barium containing smoke suppressant additive resulted in a significant reduction in visible smoke as measured by the PHS smokemeter and also in the Hartridge smoke density readings. Visually, the effect was dramatic, and, although the engine was operated with the treated fuel only a short time, the smoke reduction did improve with time. These data, not a part of the current program, are presented to indicate that this particular smoke additive apparently worked on the Ford cab-over truck-tractor taken from normal rental service. It should be noted that this tractor was in good repair and was not classed as an excessive "smoker." These limited data do not justify an opinion that the additive will effect a corresponding improvement in engines classed as "inherent smokers."

Several weeks after the initial exploratory smoke studies, extensive smoke measurements were obtained under constant speed and acceleration type vehicle conditions. From the initial road small panel odor and smoke studies and the previously discussed smoke experiments in the dynamometer laboratory, it was known that the most significant levels of smoke occurred under maximum engine fueling conditions during both constant speed and acceleration conditions. To determine the effect of load on various operating conditions, a series of constant vehicle speed and engine speed conditions was investigated at 20-hp increments from 0 up to open rack maximum power. The results of this series of smoke experiments are tabulated in Tables 18 through 21. Table 18 operation was in 7th gear; Tables 19, 20 and 21 operations were with the transmission in 8th, 9th and 10th gears, respectively. Each table includes engine speeds of 1400, 1500, 1700, 1900, 2100 and 2300 rpm (2200 rpm was used where 2300 rpm could not be attained). The smoke measurements in Tables 18 through 21 indicate that constant speed smoke emissions were not significant, i.e., above approximately 10 percent, until the last 15 to 25 hp of the engine were obtained. Then, it was not uncommon for the smoke to practically double or more than double as indicated by the PHS smokemeter percent absorbance. Looking at the data in Tables 18 through 21 from the effect of engine speed on smoke produced, it is apparent that the extremes in engine operating speed of 1400, 2300, and sometimes 1500 rpm did not usually produce as significant an exhaust smoke as the 1700, 1900, 2100, and 2200 rpm higher power output conditions. The maximum smoke readings ranged from 15 to 17 percent in 7th gear, 16 to 19 percent in 9th gear, and 17 to 21 percent in 10th gear. The particular drive gear had little apparent effect on the maximum smoke produced, that being more dependent on fuel rate or power level and engine speed.

An extensive investigation was also made of transient operation on its production of visible smoke. By use of a 0 to 100-mv potentiometric strip chart recorder, the PHS smokemeter was satisfactorily used to investigate fast changing transient operating conditions. For example, the PHS instrument readout could show engine start (one black puff) and every shift point during the acceleration through the ten forward gears. Numerous idle-acceleration conditions with various loads impressed in the water brake dynamometer were investigated. The results are shown in Table 22 for the most significant smoke levels recorded, including engine start and the average maximum readings obtained during acceleration through each of the ten forward speeds. The first black puff on engine start consistently resulted in the greatest smoke intensity of from 30 to 48 percent light absorbance. Although this is greater than the 24 to 34 percent recorded for the bus, the engine start condition is a momentary and little used operation in normal highway operations. Even at truckstops for as long as 1 hour, the engine may be left idling. An analysis of Table 22 data indicates that the higher readings occurred in the last four to five gears operated. As more and more load was impressed in the dynamometer at 30 mph and retained, the significant smoke conditions appeared in only the last two or three gears operated. From the strip chart records of engine and vehicle speed, it was evident that the higher impressed dynamometer loads resulted in longer acceleration periods but in little or no difference in peak exhaust smoke. As was discussed in Section II, more significant transient smoke producing conditions appeared to exist during full rack acceleration in 6th, 7th, 8th, 9th and 10th gears. Also, the duration of the blacker smoke increased with increasing transmission gear number. The smoke emitted during the lower gears (1st to 5th) did not appear as significant as the last five. The laboratory smoke investigations of similar acceleration conditions utilizing 32,000 pounds of vehicle weight inertia simulation showed essentially the same trends as the field studies. Shown in Figures 1 and 2 of Appendix D are two typical PHS smoke measurement traces made during the acceleration runs.

Summarizing the smoke measurement procedural development effort, it appears that measurements under constant speeds in 7th gear and 9th gear at 1700, 1900 and 2100 rpm under full rack engine output should be considered for purposes of the variability study. In addition, an acceleration at full rack from 5th into 6th and on up to 10th gear, under a 40-hp load impressed at 30 mph and retained, should be sufficient to determine the transient, acceleration, smoke levels. Replicate runs should be conducted with the smokemeter light beam located 5-1/2 inches above the tip of the exhaust stack.

V. VEHICLE VARIABILITY STUDY

This section describes the results of the vehicle variability portion of this program. The objective of this phase was to determine the variability of the odor and smoke emissions from a typical group of ten identical buses and ten identical trucks. These studies were performed using the PHS smoke and odor measurement methods, measurement facilities, and the panel and dynamometer procedures previously discussed. Since this phase depended on the successful completion of the field studies, facility development and procedural development portions of the program, the study of variability was necessarily scheduled at the end of the program period. A statistical analysis of the data, beyond the scope of this program, is under consideration by the Public Health Service. The results and data are discussed in the following subsections for the ten buses and ten truck-tractors evaluated.

A. Bus Results

The results of the odor and smoke evaluations for all ten GM Truck and Coach Model TDH 4519, 45-passenger, city buses powered by the Detroit Diesel Division, two-cycle, 6V-71 engine equipped with S-60 unit injectors are included as Appendix E*. Table 1 lists the ten similar units evaluated, their mileage at date of evaluation and the tables which contain the odor or smoke evaluation results. Each bus was given a series number for identification purposes during the tests, and all numbers on the bus were obscured or covered from accidental view by the panelists. As may be noted from Table 1, each bus had accumulated mileage varying from a minimum of 204,494 to a maximum of 245,161 miles. Buses obtained from the San Antonio Transit System terminal were prepared for test the night before the evaluation in order to complete a smoke and odor evaluation in one working day. The preparation involved inflation of all four rear tires to 100 psig, inspection of drive tires and removal of rocks, etc., installation of the AC tachometer-generator assembly on the engine, obscuring the bus identification numbers, and connection of a separate fuel system including purging and check-out. The separate fuel system consisted of a 55-gallon "day-tank" located adjacent to the rear of the engine compartment and suitable supply and return hoses. The large "day-tank" was employed to simulate the vehicle fuel tank and permit normal fuel supply and return rates. The "day-tank" was supplied from a 1000-gallon tank containing a known commercial number 1 grade diesel fuel. This fuel, purchased especially for this program under San Antonio Transit System specifications, is described in part C of this section. For purposes of discussion, the bus results, contained in Appendix E, are reported separately, first odor and then smoke.

1. Odor

The odor measurement conditions procedures employed during the vehicle variability studies were not only important to this study but tend to begin a precedent for future evaluation of control devices, techniques, fuels and additives. Accordingly, a special conference was held at the National Air Pollution Control Center, Cincinnati, Ohio, on December 6, 1966, with the Project Officer, Ralph Stahman; Andrew Rose; George Kittredge; Howe Hopkins; Don Hill, U. S. Public Health Service; and Karl Springer, Southwest Research Institute for the purpose of selecting bus odor and smoke operating conditions and for deciding on measurement procedures from those developed. As a result of this meeting and consequent development of a satisfactory hot-idle procedure (previously discussed under Section IV. A. Bus Procedural Development), it was agreed the following conditions be employed during the bus odor variability study:

Condition	Vehicle Speed, mph	Vehicle Power, hp
I - Constant Speed	20	40
II - Constant Speed	40	40
III - Constant Speed - Idle	--	--
IV - Idle-Acceleration	0-35	30 hp at 30 mph (initially impressed)
V - Constant Speed - Deceleration	40-0	40 hp at 40 mph (initially impressed)

Note: All the above operated under full bus inertia simulation via SwRI system.

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*All of the tables called out in this section, "V. A. Vehicle Variability Study," are presented in Appendix E except those identified as "of this text."

It was also mutually agreed to conduct the above odor evaluations at a single dilution, the dilution which resulted in the most intense odor and was representative of what a motorist or pedestrian typically might experience, namely, a 100:1 dilution level. This dilution ratio had been determined as a reasonable minimum dilution level under a variety of traffic and operating conditions during the field dilution studies reported in Section II.

Throughout the ten-bus variability study, the odor was evaluated under the aforementioned conditions, also listed in Table 2 of Appendix E. The human panel and dynamometer operating procedures developed and utilized to evaluate the five different vehicle operating conditions are described in Tables 3 through 6. These procedures are similar to those described in Section IV except for the selection of a single (100:1) dilution ratio. Table 3 contains the two constant speed conditions at 20 and 40 mph under 40-hp vehicle load conditions, operating Conditions I and II, respectively. Table 4 describes the hot engine idle odor evaluation condition, Condition III, which represents a typical bus engine idle immediately after a constant speed cruise. This condition is similar to that repetitively experienced during routine municipal bus operation. The transient idle-acceleration and constant speed-deceleration conditions employed, Conditions IV and V, are described in Tables 5 and 6, respectively.

The results for the ten-bus vehicle variability odor study are continued in Appendix E. The odor panel evaluation for each bus is summarized in Tables 7 through 16. These summaries indicate the panel responses for each of the five operating condtions and list the average of the four runs made under each condition. Additional information regarding panel responses for each of the five odor qualities is given in the five supporting tables after each summary. For example, Table 7 groups the twenty runs, five conditions repeated four times, which constituted an odor evaluation for a bus by Condition I--20-mph constant speed, Condition II--40-mph constant speed, Condition III--hot idle, Condition IV--idle-acceleration, and Condition V--constant speed-deceleration. This grouping indicates the maximum and minimum average panel response as well as the overall four-run panel response for each of the five qualities. The summary data were obtained from the five supporting tables, Tables 7A through 7E. Each of these tables shows the panel response distribution for each of the twenty odor evaluation runs and the five "blank" runs. The "blank" runs served the dual purpose of giving the panelists a break from the generally intense exhaust odors experienced at 100:1 dilution and ascertained the amount of odor hang-up in the dilution and presentation system. These runs, conducted in random order, were performed the same as the other runs except with a solid or "blank" orifice placed in the sample system. The results of the "blank" runs are listed in the group of supporting tables for each bus series. The overall diesel "D" composite responses are listed in Table 7A, the "B" Burnt-Smoky responses in Table 7B, the evaluation against the "O" Oily standard in Table 7C, the panel response to the "A" Aromatic-Aldehydic quality in Table 7D, and Table 7E contains the response distribution for the "P" Pungent odor quality standard. The next nine sets of tables are similarly organized. The individual panel results were reduced, summarized, and included in Appendix E to permit a statistical analysis and study of the vehicle variability data. In addition, carbon copies of each panelist's data sheet were submitted to the Project Officer for Public Health Service study. A sample data sheet was included in Appendix C.

For purposes of discussion of the results of the bus odor study, Table 1 of this text, which is identical to Table 17 of Appendix E, will be helpful. Contained in Table 1 of this text are the overall four-run averages for each bus tested, for each condition and for each quality. The table was organized to present by quality these overall averages from Tables 7 through 16 for each of the ten-bus evaluation series. Listed at the top of Table 1, this text, are all the "D" diesel composite results for Conditions I through V. For example, the results from the 20-mph, 40-hp constant speed drive range operation, ConditionI, varied from 5.8 for bus Series 8 to 7.2 for bus Series 5. Similarly, the "D" response overall average from the remaining steady state and transient operating conditions may be analyzed for each evaluation series. This type of analysis will permit a preliminary indication of the magnitude of "D" response variability within the ten buses studied.

Shown next, in Table 1 of this text, are the "B" Burnt-Smoky results for the ten buses. Each value, presented for each of the five operating conditions, represents a four-run average of the average response of the ten panelists. The range of results for each operating condition may be determined by considering each line of this table. For example, the idle-acceleration, Condition IV,

TABLE 1. SUMMARY OF BUS VARIABILITY STUDY ODOR EVALUATION RESULTS

Operating Condition (1)	Odor Quality (2)	Municipal Bus Series										Overall Average
		1	2	3	4	5	6	7	8	9	10	
I.	D	7.1	6.6	6.6	6.1	7.2	6.8	7.1	5.8	5.9	7.0	6.6
II.	D	7.1	7.2	7.8	6.5	6.3	7.2	6.6	6.8	6.8	8.0	7.0
III.	D	7.7	7.1	7.3	6.6	6.4	7.6	7.8	6.8	7.6	7.5	7.2
IV.	D	7.3	8.1	8.4	8.5	8.2	7.9	8.4	7.2	7.4	7.7	7.9
V.	D	7.8	7.7	7.5	7.3	8.4	8.5	8.9	5.0	7.0	8.2	7.6
I.	B	2.5	2.2	2.0	2.2	2.6	2.2	2.5	1.7	1.9	2.2	2.4
II.	B	2.3	2.4	2.6	2.2	2.2	2.5	2.3	2.3	2.4	2.8	2.4
III.	B	2.6	2.7	2.4	2.2	2.3	2.6	2.7	2.3	2.6	2.6	2.5
IV.	B	2.4	3.0	2.9	2.8	2.9	2.8	3.0	2.5	2.4	2.6	2.7
V.	B	2.9	2.8	2.5	2.8	2.9	3.0	3.1	1.3	2.2	2.7	2.6
I.	O	2.1	1.9	1.9	1.8	2.0	2.2	2.1	1.6	1.8	2.0	1.9
II.	O	2.1	2.3	2.4	2.0	1.8	2.4	2.2	2.0	2.2	2.3	2.2
III.	O	2.0	1.9	2.0	1.8	1.8	2.2	2.2	2.0	2.4	2.2	2.1
IV.	O	2.4	2.6	2.5	2.7	2.6	2.7	2.8	2.0	2.2	2.4	2.5
V.	O	2.3	2.3	2.1	2.6	2.6	2.5	2.9	1.3	2.1	2.4	2.3
I.	A	1.5	1.3	1.5	1.6	1.6	1.3	1.7	1.2	1.3	1.1	1.4
II.	A	1.4	1.8	2.0	1.7	1.3	1.5	1.9	1.5	1.3	1.4	1.6
III.	A	1.7	1.9	1.8	1.5	1.7	1.8	2.2	1.7	2.0	1.9	1.8
IV.	A	1.7	2.1	2.0	2.1	1.9	1.9	2.0	1.7	1.9	1.7	1.9
V.	A	2.1	2.1	1.7	2.2	2.1	2.2	2.3	0.7	1.7	1.4	1.9
I.	P	1.1	1.0	1.0	1.0	1.3	1.4	1.6	0.7	0.8	1.2	1.1
II.	P	1.2	1.3	1.6	1.1	1.1	1.4	1.2	1.1	1.2	1.6	1.3
III.	P	1.5	1.6	1.3	1.6	1.4	2.0	1.8	1.3	1.6	1.3	1.5
IV.	P	1.4	1.9	2.0	1.6	1.9	2.0	2.2	1.4	1.4	1.4	1.7
V.	P	1.5	1.8	1.5	2.1	2.1	2.1	2.4	0.3	1.5	1.6	1.7

(1) I. Constant speed at 20 mph, 40 hp
II. Constant speed at 40 mph, 40 hp
III. Idle after constant speed operation
IV. Acceleration after 1 minute idle
V. Deceleration after constant speed

(2) "D" Diesel composite results
"B" Burnt-Smoky results
"O" Oily results
"A" Aromatic results
"P" Pungent results

"B" responses varied from 2.4 for bus Series 1 and 9 to 3.0 for Series 2 and 7. In identical fashion, the "O" Oily, "A" Aromatic-Aldehydic, and "P" Pungent quality overall responses are presented and may be similarly considered. Although this study did not include a statistical analysis of the data, some interesting comparisons and comments may be made between buses, between conditions, and between the "D" overall composite and the four quality standards. For example, not all the diesel powered buses appeared to have the same odor emissions as measured by the human panel-odor quality/intensity system. Evaluation Series 8, bus 684, had less intense odor emissions than any of the other ten buses surveyed. This was apparent not only from the "D" but from each of the four qualities. Bus 685, Series 9, produced a slightly more intense odor than bus 684, Series 8. Both these units were lower than the remainder of the buses. Evaluation of Series 7 and 6, buses 683 and 682, seemed to have the highest overall intensity. The difference between the lowest and highest bus intensity was approximately 1.2 for the "D" responses. It should be recalled that a "D" 5 standard is half as intense as a "D" 6 standard. When considered from this perspective, the variability between the bus odor response data takes on additional significance. Significant differences also were apparent between Series 7 and 8 for the four quality standards of the "B," "O," "A," and "P" results. The greatest difference was noted between the Pungent "P" response. Although the "B," "O," and "A" differences were not striking, the large difference in pungency may account for the significant difference in the overall "D" results. A review of the Table 1, this text, data also points out that of the five operating conditions employed, Condition IV, the idle-acceleration appears to produce the most intense and significant level of diesel odor. Another transient condition--operating Condition V: a deceleration following a high-speed, high-power, cruise--was apparently the next most intense of the five conditions. These conclusions are indicated by the overall average of the odor responses shown in the last column of Table 1 of this text for each bus evaluated. Use of this "average of an average" beyond this level of interpretation should be avoided, especially since the data were reduced by simple arithmetic, and no statistical weighting was employed to account for the odor kit dilution series, obviousness of odor, etc. It should be reported that odor evaluation of ConditionI, the 20-mph, 40-hp constant speed condition, did not indicate the sickening-sweet, sometimes nauseating, type of odor panel reaction experienced. This particular condition may not be important since operation at 20 mph in drive gear at appreciable power may, in routine situations, seldom occur. Recommended operating practice would be to allow the vehicle to downshift, at which time the engine will operate at a much higher speed and deliver increased torque, power and a different odor.

Pertinent engine maintenance for each of the ten buses evaluated is continued in Table 32. These ten units, all purchased in April 1963, had approximately the same mileage of about 204,000 to 245,000 miles. Except for bus 681, Series 5, which had a major overhaul at 201,483 miles, each bus engine had the original engine rings, pistons, bearings, etc. To maintain engine performance, only injector maintenance and engine tune-up were accomplished. Shown in the last column of Table 32 is the bus mileage since the last injector change and engine tune-up were performed. It is interesting to note that buses 684 and 685, which produced less odor than buses 682 and 683, were the units with the highest total mileage of the group. Additionally, the injectors in these two buses had not been changed for over 70,000 miles. On the other hand, buses 682 and 683 had 215,891 and 204,494 total miles, respectively, and the engines had operated 44,891 and 72,494 miles since the last injector change and tune-up. Apparently, the odor produced by these ten vehicles as measured by the human panel had little relationship to total engine miles or injector maintenance. It should be pointed out, however, that the maintenance of the San Antonio Transit buses is above average as indicated by the numerous fleet maintenance awards received by their maintenance division.

2. Smoke

Smoke evaluation conditions and procedures used in the ten-bus variability study were also discussed during the previously reported December 6, 1966 meeting with the Public Health Service officials. As a result, SwRI was advised to measure the buses' visible exhaust, using the PHS smokemeter and exhaust pipe adapter (Section III.A.), under the following conditions:

Condition	Vehicle Speed, mph	Vehicle Power Output
A - Constant Speed	20	Open Rack (max power)
B - Constant Speed	25	Open Rack (max power)
C - Constant Speed	30	Open Rack (max power)
D - Constant Speed	35	Open Rack (max power)
E - Idle-Acceleration	0-40	30 hp at 30 mph (Initially impressed)
F - Idle-Acceleration	0-40	40 hp at 30 mph (Initially impressed)

Note: All of the above operated under full bus inertia simulation via SwRI systems. All accelerations at open rack.

Throughout the variability study, the visible smoke emissions were measured under the aforementioned six conditions, also listed in Table 18. The dynamometer and smoke measurement procedures for the first four constant speed conditions are described in Table 19. The vehicle smoke produced from these steady state conditions, operated at full rack, maximum power, at 20, 25, 30 and 35 mph, was measured with the PHS smokemeter located 12 inches from the tip of the exhaust pipe adapter. It should be noted that all four conditions were operated with the automatic transmission in the "up" or drive range. This meant that the vehicle was accelerated through upshift, approximately 24 to 26 mph, and then loaded back to 20 mph. Downshift generally occurred at 17 mph on a normal deceleration, but, where the vehicle speed was slowly decreased such as during the constant speed tests, some vehicles would downshift at 20, 21 and sometimes 22 mph. For those vehicles with an early downshift characteristic, the 20-mph condition was run as near to 20 mph as possible without downshift.

Table 20 contains the operating procedure for the transient idle-acceleration smoke measurement condition. Using a suitable 0 to 100-mv potentiometric null balance strip chart recorder, an indication of the first black puff on engine start, the start of acceleration, and upshift to drive gear, was continuously obtained. Two similar transient smoke measurements were obtained: (1) with 30 hp initially preset, impressed in the water brake type dynamometer and retained, and (2) with 40 hp set into the dynamometer and retained throughout the acceleration. The entire group of six smoke conditions was conducted four times with the full bus inertia, 24, 640 pounds, simulated by the SwRI inertia system.

The results of the smoke variability studies are listed in Tables 21 through 30 for the ten buses investigated. Each table presents the maximum, minimum and average of the four runs at each of the four constant speed, two idle-acceleration conditions. All of these tests, on a reference number 1 fuel described later in this section, were conducted after each day's odor evaluation with a well-warmed engine. The absorbed vehicle load during the maximum power runs is also listed for each constant speed condition. The idle-acceleration data include an engine start measurement, although this operation, depending on driving habit and instructions, may seldom be used. The maximum, minimum and average full rack start of vehicle acceleration and point of automatic transmission upshift, previously determined as definable significant smoke points during vehicle acceleration, are then listed for both idle-accelerations.

To facilitate discussion of the ten-bus smoke variability study, the overall summary of the test results, Table 31 of Appendix E, is repeated as Table 2 of this text. Similar to the ten individual tables of smoke results in Appendix E, the four constant speed conditions are listed first, followed by the two slightly different idle-acceleration operations. As in the discussion of the odor summary, several trends are apparent from a review of the Table 2, this test, values even though a statistical analysis has not yet been made. It is obvious that there was a fairly wide range of smoke emissions from this sample of ten identical units. Experimental Series 6, bus number 682, produced the lowest level of

TABLE 2. SUMMARY OF BUS VARIABILITY STUDY SMOKE EVALUATION RESULTS

Type of Operation	Vehicle Speed, mph	Municipal Bus Series 1	2	3	4	5	6	7	8	9	10	Overall Average
A - Constant speed	20	16.8	14.0	23.3	19.0	19.1	8.8	14.5	20.0	20.6	15.5	17.2
B - Constant speed	25	14.9	11.3	20.1	17.6	13.3	6.3	9.3	16.1	15.4	13.5	13.8
C - Constant speed	30	14.3	11.4	19.8	16.5	14.4	6.6	6.9	14.4	13.3	14.5	13.2
D - Constant speed	35	12.0	9.8	12.4	12.1	12.1	5.1	6.0	11.8	10.9	10.5	10.3
E - Idle-Accel (30 hp at 30 mph)	Start	23.3	16.3	20.0	24.5	19.9	18.1	21.3	30.9	27.9	33.0	22.5
	Accel	11.0	8.8	9.9	9.5	7.1	3.0	4.8	8.5	8.0	9.3	8.0
	Upshift	13.3	12.3	19.8	18.1	12.1	5.3	7.5	13.9	14.6	12.9	13.0
F - Idle-Accel (40 hp at 30 mph)	Start	23.5	[illegible]	18.3	26.3	16.8	26.8	19.8	31.5	29.3	33.0	24.1
	Accel	12.9	6.9	8.6	9.3	6.9	2.5	4.1	7.9	8.0	11.0	7.8
	Upshift	13.3	11.8	19.0	17.6	12.1	5.0	7.5	14.0	14.6	13.0	12.8

(1) All constant speed smoke measurements made at maximum power output in drive range.

All idle-acceleration smoke measurements made at open rack with full inertia simulation.

exhaust smoke under each of the six conditions. The constant speed average values for this unit ranged from about 5 to 8-percent absorbance. This level of smoke emission was fairly low compared to Series 3 which had an overall smoke emission of 10 to 24-percent absorbance for an average of about 17 percent, three times as great as Series 6 which had an average of about 5-percent absorbance. This range of results indicates a fairly wide variability among buses even though they were of the same make, power system, had about the same mileage, and were tested identically using the same fuel. Bus experimental Series 1, 2, 5, 8, 9 and 10 seemed to produce visible smoke nearer the average of about 12-percent absorbance. These results might be tempered slightly by adjustment or deletion of Condition A, the 20-mph drive range maximum power condition. This condition is representative of sustained, steep uphill driving in which the bus operator has experienced a gradual deceleration but has not allowed the vehicle's automatic transmission to downshift to the low drive range. This type of maximum power operation, at an engine speed of about 900 rpm, was conducive to the production of smoke. This condition, however, is considered representative of occasional operation of this type of equipment in certain cities in the United States, especially those which have numerous hills.

On completing the entire ten-bus smoke survey, the results were briefly reviewed and the San Antonio Transit System apprised of those units which seemed to smoke more than others. Bus 677, the unit tested during Series 3, was road tested by the fleet operator as a check for excessive smoking. The considered opinion was that the exhaust smoke, under the possibly milder level road conditions, was not excessive. This evidence tended to corroborate the initial road survey in which various smoke operating conditions were surveyed. It seems that the dynamometer procedures developed may tend to produce slightly more smoke than the levels which normally occur on the road. Use of the chassis dynamometer and PHS smokemeter results in a stringent, sensitive, vehicle test. The simplest way to reconcile the indication that the laboratory smoke was greater than that in the field would be to measure the net fuel consumption of the vehicle on the road under significant smoke conditions. These conditions could then be repeated in the laboratory by adjusting the power output to result in an identical fuel consumption rate.

Considering the range of variation in visible smoke discharge relative to engine maintenance and condition, it appears that the total mileage or miles since last injector change and tune-up were not significant factors. As reported in Table 32, bus 677 (Series 3) and bus 682 (Series 6), which discharged the highest and lowest smoke intensity, respectively, of the ten units tested, had almost equal mileage, 226, 541 versus 215, 891, and equal miles since last injector maintenance and engine tune-up of 56, 541 and 44, 891 miles, respectively. The maximum engine power output of these two extremes, another indicator of engine and drive train condition, may be noted by comparing the respective vehicle load data of Table 23 for the high smoke Series 3 (bus 677) and of Table 26 for the low smoke Series 6 (bus 682). The open rack maximum power output of each vehicle was almost identical at the 20, 25, 30 and 35-mph vehicle speeds investigated, indicating essentially no difference in vehicle power condition. Accordingly, the variation in smoke production from these two buses does not appear related to either total mileage, mileage since the last injector change and tune-up, or power output of the vehicle. Further investigation is necessary to determine the reason for this spread in results. One approach useful in clarifying this difference would be to perform an injector change and tune-up on both buses and retest the exhaust smoke and vehicle power output. This would answer the question of possible injector deterioration of bus 677.

B. Truck-Tractor Results

Included as Appendix F* are the odor and smoke variability study results from the survey of ten similar intercity truck tractors. Table 1 lists the ten units evaluated, their mileage at date of test, and the tables which list the odor or smoke evaluation results. Since it was not possible to locate an available single fleet of ten similar tractors, the test group necessarily included the previously employed Ryder Ford tractor, four White Freightliners from ABC Rental, San Antonio agent for National Leasing, and five International Harvester units from Howell Refining Co., a local refiner of special fuels and petroleum products. Three units were in rental or transit status, and the remaining seven tractors were in continued use in a variety of trucking operations and may be considered representative of everyday intercity highway usage. All ten of the cab-over type units were powered by similar Cummins NH 220, naturally aspirated, four-valve, six-cylinder, 743-cubic inch, four-cycle diesel engines equipped with the PT type pump. The remainder of the drive train consisted of Fuller RT9-10 Road Ranger, ten-forward-speed transmissions, and tandem axles, 4.10:1, single-speed Eaton rear axles with interaxle differential. The drive tire size was 10.00 × 20 except for the five Howell tractors which had 10.00 × 22 size tires. All mufflers were side-mounted at the right rear corner of the cab except for the Ford tractor muffler which was located under the tractor frame near the right saddle tank. For purposes of the odor and smoke tests, each truck tractor was given an experimental series number and was identified only by this series number to the odor panel. As noted on Table 1, the tractor mileage, at date of test, varied from the fairly new 1966 Ford of approximately 76,000 miles to the Howell Refining, International Harvester truck 282, Series 6, of approximately 370,000 miles. Evaluation of the odor and smoke emissions required a full working day to complete per tractor. As in the survey of ten city buses, the odor evaluation was conducted first, followed by smoke measurement. Each unit was prepared for evaluation during the night prior to test. The pretest preparation included tire inspection, removal of rocks, etc., mounting the tractor on the dynamometer and repositioning the rear movable dynamometer to accommodate the varied axle spacings. When the rear movable portion of the chassis dynamometer was moved, this also meant repositioning and realignment of the large inertia wheel, which simulates 16,000 pounds of vehicle weight, coupled to the absorber roll. Other preparations included trimming the 4-inch diameter exhaust stack to obtain a straight circular cross section of exhaust discharge, connection of the 4-inch flexible exhaust and 5-inch diameter stainless steel exhaust duct (for odor measurement purposes only), and connection of the laboratory AC tachometer drive in place of the normal tachometer. As in the bus study, a separate fuel system was employed, using a 55-gallon "day-tank" located adjacent to the left saddle tank at the left rear corner of the cab, to simulate the vehicle fuel tank and permit normal fuel supply and return fuel rates. The "day-tank" and engine were supplied from a 1000-gallon tank containing a known commercial, number 2 grade, diesel fuel. This fuel, designated "Reference Number 2" and purchased specifically for this program under the nationally used Ryder Truck Leasing Company fuel specification, is described later in this section. The truck odor and smoke results are discussed separately in the following paragraphs.

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*All of the tables called out in this section, "V. B. Vehicle Variability Study," are presented in Appendix F except those identified as "of this text."

1. Odor

Prior to conducting this phase of the program, the operating conditions and measurement procedures for the truck-tractor odor and smoke evaluation were discussed with the Project Officer. A meeting for this purpose was held on January 11, 1967, at the Wolverine Hotel, Detroit, Michigan, with Ralph Stahman, PHS, and Karl Springer, SwRI, in attendance. It was mutually agreed to determine the variability of the ten similar truck-tractors under the following six operating conditions:

Condition	Transmission Gear	Engine Speed, rpm	Vehicle Speed, mph (approx)	Vehicle Load, hp
I - Constant Speed	7	1700	26	150
II - Constant Speed	7	2100	33	150
III - Idle	N	~575	--	0
IV - Idle-Acceleration	1	1500	0-8	0
V - Acceleration	9	2100	43-53	60 at 43 mph
VI - Constant Speed-Deceleration	9	2100	52-0	160 at 52 mph

Note: All the above operated under 32,000 pounds of vehicle weight inertia simulation via SwRI system.

On the advice of the Project Officer, it was decided to expose the panel to the lowest reasonable exhaust dilution experienced during the field studies, namely 700:1. This dilution ratio had been determined as a reasonable minimum dilution level for the 4-inch vertical truck exhaust during the field studies of Section II. This dilution was representative of what a motorist or pedestrian typically might experience under a variety of traffic conditions.

Accordingly, the odor was evaluated under the aforementioned six conditions, also contained in Table 2. The chassis dynamometer vehicle and human panel operating procedures developed and employed to measure odor from the six operating conditions are described in Tables 3 through 7. Except for the selection of a single dilution ratio and minor refinement, these procedures are identical to those described in Section IV. Contained in Table 3 are the two 7th gear constant speed conditions, Conditions I and II, at 1700-rpm engine speed (approximately 26 mph) and at 2100 rpm (approximately 33 mph), respectively. Both of these conditions were conducted at 150 hp, a near maximum engine power condition. Table 4 describes the hot engine idle odor condition, Condition III, which might be experienced during truck operation in traffic on a urban truck route through town. Three transient operating conditions, an idle-acceleration (Condition IV), an open rack acceleration in 9th gear (Condition V), and a closed rack deceleration after a maximum power cruise (Condition VI), are described in Tables 5, 6, and 7, respectively.

The odor evaluation results for the ten tractors are summarized in Tables 8 through 17. These summaries were organized to show the human panel responses for each of the six operating conditions by listing the average for each of the four runs randomly made at each condition and the overall average of each tractor at each condition. Data regarding panel responses for each of the five odor qualities are given in the five supporting tables after each summary. As an example, Table 8 groups the twenty-four runs, six conditions repeated four times, which constituted an odor evaluation for a truck tractor by Condition I--1700-rpm constant engine speed, Condition II--2100-rpm constant engine speed, Condition III--idle, Condition IV--idle-acceleration, Condition V--acceleration in 9th gear, and Condition VI--deceleration. In this way, the summary table indicates the maximum and minimum average panel responses, as well as the overall panel response for the four runs at each of the five qualities. Similar to the bus variability study, the summary data were obtained from Tables 8A through 8E. Each of these tables shows the panel response distribution for each of the twenty-four odor evaluation runs and the four "blank" runs interspersed randomly in the selected odor runs. The construction of these supporting tables and the use of "blank" runs were identical to that previously discussed for the bus variability study. The overall diesel composite "D," Burnt-Smoky "B," Oily "O," Aromatic-Aldehydic "A," and Pungent "P" panel responses and distributions for tractor Series 1 are listed in Tables 8A, 8B, 8C, 8D, and 8E, respectively. The remaining nine sets of data, in tabular form covering experimental Series 2 through Series 10 tractors, are similarly organized. These data, reduced and summarized from the individual judgments of the ten-person panel, were included in Appendix F to allow a statistical analysis of the variability which might be expected within a group of ten similar tractor vehicles. In addition, carbon copies of each panelist's raw data sheet were submitted to the Project Officer for Public Health Service review and consideration.

To enable discussion of the results of the tractor exhaust odor study, an overall summary of the results of the odor evaluation of the ten tractors, Table 18 of Appendix F, is repeated as Table 3 of this text which is organized the same as the Table 1, this text, odor summary for the ten buses. The panel responses are listed for each of the experimental series for each of the ten tractors evaluated. The "D" diesel composite results are tabulated first, followed by similar groupings for the "B," "O," "A" and "P" responses. The values presented for the three steady state and the three transient operating conditions represent an average of four separate run averages. Each run average represents an arithmetic mean of the ten-person panel judgment. An idea of the range of variation by condition for all ten tractors or for a single tractor for all six conditions may be obtained from review of this table. For example, the "D" response for Condition I, the 1700-rpm, 150-hp, constant speed operation, varied from a low value of 1.5 for Series 4, tractor 125, to a high of 3.9 for Series 5, tractor 135. The range of "D" variability during, for instance, Series 1 was 3.0 for Condition I and 5.4 for the deceleration condition, Condition VI. Shown in the last column is the average of the entire ten experimental tractors for each of the six conditions by odor quality.

TABLE 3. SUMMARY OF TRUCK VARIABILITY STUDY ODOR EVALUATION RESULTS

Operating Condition(1)	Odor Quality(2)	Truck-Tractor Series										Overall Average
		1	2	3	4	5	6	7	8	9	10	
I	D	3.0	2.8	3.3	1.5	3.9	2.8	3.2	2.5	2.5	3.4	2.9
II	D	3.1	2.7	2.0	2.1	2.8	2.2	1.5	1.2	2.5	3.3	2.3
III	D	4.2	3.8	4.1	4.2	3.1	3.5	3.9	2.9	4.1	4.5	3.8
IV	D	3.9	2.9	4.0	3.0	3.1	2.9	3.3	2.3	2.3	3.5	3.1
V	D	3.5	2.4	3.9	3.3	3.7	2.7	2.9	2.0	3.6	2.8	3.1
VI	D	5.4	4.2	5.3	4.7	5.9	4.9	4.6	4.0	4.6	5.5	4.9
I	B	0.7	0.8	0.8	0.3	1.1	0.7	0.7	0.4	0.5	0.5	0.7
II	B	0.6	0.7	0.4	0.6	0.6	0.6	0.3	0.3	0.5	0.9	0.5
III	B	0.9	0.9	1.0	1.1	0.9	0.9	0.9	0.7	1.0	1.1	0.9
IV	B	0.9	0.8	1.1	0.7	0.7	0.6	0.8	0.5	0.4	0.6	0.7
V	B	0.7	0.6	0.9	0.8	0.9	0.7	0.7	0.4	0.8	0.7	0.8
VI	B	1.4	1.1	1.5	1.1	1.8	1.3	1.4	1.1	1.2	1.5	1.2
I	O	0.8	0.7	0.8	0.6	0.9	0.8	0.8	0.8	0.5	0.7	0.7
II	O	0.7	0.7	0.8	0.8	0.6	0.6	0.5	0.4	0.7	0.8	0.7
III	O	0.9	0.8	0.9	1.0	0.7	1.0	0.8	0.8	1.1	1.2	1.0
IV	O	1.0	0.8	1.0	0.9	0.7	1.0	0.8	1.0	1.0	0.9	0.9
V	O	0.9	0.8	0.8	0.9	0.8	0.9	0.9	0.8	1.0	0.9	0.8
VI	O	1.1	1.0	1.3	1.1	1.3	1.1	0.9	1.0	1.2	1.5	1.2
I	A	0.7	0.6	0.9	0.4	0.8	0.7	1.0	0.8	0.5	1.0	0.7
II	A	0.8	0.5	0.5	0.6	0.7	0.6	0.2	0.3	0.3	0.8	0.5
III	A	0.9	0.9	1.0	1.0	0.6	0.8	0.8	0.8	0.8	0.8	0.8
IV	A	1.0	0.6	0.9	0.8	0.7	0.8	0.9	0.5	0.5	1.1	0.8
V	A	0.7	0.5	0.9	0.8	1.0	0.7	0.7	0.6	0.7	0.7	0.7
VI	A	1.0	0.8	1.1	1.1	1.3	1.1	0.8	0.9	0.9	0.8	1.0
I	P	0.1	0.2	0.1	0	0.4	0.1	0.1	0.4	0	0.5	0.2
II	P	0.1	0.2	0	0.1	0.2	0.1	0.1	0.1	0.2	0.4	0.2
III	P	0.4	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.6	0.9	0.4
IV	P	0.1	0.3	0.2	0.2	0.3	0	0.3	0.2	0.1	0.4	0.2
V	P	0	0.1	0.2	0.2	0.5	0.1	0.2	0.1	0.5	0.5	0.2
VI	P	0.4	0.4	0.6	0.6	1.0	0.4	0.5	0.5	0.6	1.1	0.6

(1) See Table 3 for explanation of operating conditions.

(2) "D" Diesel Composite Results
"B" Burnt-Smoky Results
"O" Oily Results
"A" Aromatic Results
"P" Pungent Results

Although a statistical analysis of the Table 4 data is not available, some comments can be offered regarding the truck variability, as well as the truck relative to the previously discussed bus odor data. Of the entire group of ten tractors evaluated, Series 10, tractor 283, had the greatest overall odor intensity as measured by the Q/I method, while Series 8, tractor 284, had the lowest. The overall difference between the two was explained by the major difference of about one intensity level in the "D" standard between Series 8 and Series 10. Lesser differences were noted in the "B" and especially the "O," "A," and "P" qualities. A fairly large number of tractors emitted essentially the same overall intensity including Series 2, 4, 6, 7, and 9. A study of the overall average column reveals that of the six odor producing conditions evaluated, the deceleration after a sustained maximum power cruise, Condition VI, produced the most intense odor. This is evidenced by all four qualities as well as the "D" composite. The average "P" Pungent and generally the "B" Burnt-Smoky responses showed significantly higher intensities than other conditions. Like the bus odor summary, however, care should be taken when interpreting these results because of the simplified arithmetic data reduction techniques employed.

Listed in Table 33 of Appendix F are the mileage and maintenance records for each of the ten truck-tractors surveyed. As previously indicated, the Ford H-915D, four White Freightliners, and five International Harvester DCOF 405 cab-over tractors were included in this study. The Ford unit, obtained from the Ryder Truck Leasing Company, was a 1966 model and had fairly low mileage. The four White Freightliners, obtained through ABC Truck Rental, an agency for National Leasing Company, were of varied overall mileage. The group of five International Harvester units, all involved in transport of petroleum products to and from the Howell Refinery, was comprised of identical tractors, and all had over 300,000 miles except for tractor 286. The last two columns of Table 33 indicate the pertinent engine maintenance mileage and the miles since the last fuel injector maintenance. The latter category varied from approximately 6000 to about 45,000 miles. It is interesting to consider the maintenance data relative to the maximum and minimum levels of odor from the group of ten tractors. Tractor 283, Series 10, which had the highest overall odor intensity, had undergone an engine tune-up and injector change 8267 miles before the test. At this rate of mileage accumulated on the Howell tractors, this amounted to about 2-1/2 to 3 weeks of operation. Tractor 284, Series 8, on the other hand, had undergone a similar injector and tune-up procedure 44,771 miles prior to the odor evaluation, yet this tractor had the lowest overall odor intensity. Similar to the bus injector maintenance versus odor intensity, the injector maintenance of the four-cycle powered truck-tractors seems to have little relationship to the odor of the exhaust.

Compared to the two-cycle powered bus exhaust, there was a large and significant difference in exhaust odor as indicated by the quality intensity data of Appendixes E and F, and as summarized in Tables 1 and 3 of this text. Part of this difference may be attributed to the different dilution levels employed of 100:1 for the bus exhaust versus 700:1 for the truck-tractor exhaust sample. This sevenfold difference, when compared to the "D" ratings of approximately 7.3 for the bus and 3.4 for the truck-tractor, accounts for only a portion of the difference, however. For example, an odor rating of "D" 7 is sixteen times as intense as a "D" rating of "D" 3. According to Reference 3, the concentration at any one of the twelve dilutions of the "D" diesel composite equals 2^{1-n} where the bottle number is designated n. This is equivalent to computing the differences in dilution via 2^m where m is the difference in "D" dilutions. For the difference of intensities of four dilutions, n, equals 4, and the "D" 7 rating is 2^4, or sixteen times as intense as a "D" 3 rating. Recall that a "D" 5 level is twice as intense as a "D" 4 rating, and a "D" 6 rating is twice as intense as a "D" 5 and so on. This difference in odor of the bus relative to the truck was not only shown in the overall "D" intensity but in the differences between various four-quality standards. Worthy of note were the "B" Burnt-Smoky responses which, similar to the overall "D" ratings, showed a significant reduction. The tractor exhaust appeared less pungent and occasionally more aromatic and oily than the bus. Thus, it may be stated that on the basis of the twenty different vehicles tested (ten trucks and ten buses), the Q/I diesel odor evaluation kit did enable the panel to distinguish between types of engines. Comments from odor panel members confirmed the Q/I responses and gross differences between the exhaust odor from the bus and truck. The penetrating, lasting, almost sickening, and sometimes biting effect of the harsh two-cycle powered bus exhaust was quite different from the milder, lower strength, less irritating and intense exhaust from the four-cycle powered truck-tractor.

2. Smoke

Smoke conditions and procedures for use in this study were also discussed at the previously referenced, January 11, 1967, meeting with the Project Officer in Detroit, Michigan. It was decided that smoke measurement at maximum power under both steady state and transient operating conditions should be obtained. These operating conditions, all at open rack, maximum engine power, are listed in Table 19 as follows:

Condition	Engine Speed, rpm	Drive Gear	Vehicle Speed, mph (approx)
A - Constant Speed	1700	7	26
B - Constant Speed	1900	7	28
C - Constant Speed	2100	7	32
D - Constant Speed	1700	9	40
E - Constant Speed	1900	9	46
F - Constant Speed	2100	9	50
G - Idle-Acceleration	575-2200	1 through 10	0-60

Note: All the above operated under 32,000 pounds of vehicle weight simulation via SwRI system.

The chassis dynamometer and smoke measurement procedures for the six constant speed smoke conditions, Conditions A through F, are described in Table 20. The visible smoke emitted during the 1700, 1900, and 2100-rpm engine speed in 7th and 9th gears was measured via the PHS light-extinction type full flow smokemeter mounted 5-1/2 inches above the tip of the exhaust stack. Because of slight vehicle-to-vehicle variations, the smoke conditions were conducted with engine speed rather than vehicle speed being the controlled parameter. This method was found to be more repeatable and reproducible. Table 21 lists the procedure employed to measure the smoke discharged during full rack acceleration throughout all ten forward speeds against both the simulated inertia of 32,000 pounds of vehicle weight and power absorption. A vehicle power level of 40 hp (20 hp per axle) at 30 mph, preset or impressed in the water brake dynamometer, resulted in maximum power absorption and stable operation in 10th gear. During the procedural development studies, it was found that use of the potentiometric strip chart recorder to indicate continuously the PHS smokemeter output permitted reading of the chart for the maximum smoke levels during acceleration in each gear. Since smoke levels in gears 1 through 4 were not as significant as those obtained during gears 5 through 10, only smoke in the higher gears was recorded. A commercial number 2 fuel, described in the following subsection, was used exclusively during these smoke studies.

The results of the smoke survey of the ten truck-tractors are contained in Tables 22 through 31. These tables list the maximum, minimum, and average PHS smoke readings for each of the six constant speed conditions. Also listed are the maximum, minimum and average smoke levels at engine start, one black puff, and the smoke emitted during drive gears 5 through 10. The smoke trace was analyzed during each acceleration for the average maximum smoke condition. The constant speed and acceleration data summarized in Tables 22 through 31 were based on quadruplicate runs. For ease of discussion of the smoke variability results, the overall summary of the test results, Table 32 of Appendix F, is shown on Table 4 of this text. As in Tables 22 through 31, the six constant speed smoke conditions are first listed for each of the ten trucks. The acceleration data are shown next. Although a complete statistical analysis has not been conducted on these data, several important trends in truck smoke tendencies, especially relative to the previously discussed bus survey, can be mentioned. Considering the tractors which produced the lowest and highest smoke levels, it is apparent that the lowest, Series 3 (tractor 114), produced less

TABLE 4. SUMMARY OF TRUCK VARIABILITY STUDY
SMOKE EVALUATION RESULTS

	Gear	Engine	Truck-Tractor Series										Overall
Type of Operation(1)	No.	Speed, rpm	1	2	3	4	5	6	7	8	9	10	Average
A - Constant Speed	7	1700	21.0	13.0	14.0	11.0	31.0	21.0	17.5	28.0	19.0	16.0	19.2
B - Constant Speed	7	1900	22.0	17.0	15.0	14.0	33.0	24.0	17.0	28.0	21.0	17.0	20.8
C - Constant Speed	7	2100	20.3	19.0	17.0	16.5	34.0	25.0	18.0	29.0	23.5	19.0	22.0
D - Constant Speed	9	1700	21.3	13.0	14.5	11.5	32.5	24.0	17.0	26.0	21.0	16.0	19.7
E - Constant Speed	9	1900	20.2	16.0	15.0	14.0	32.0	24.0	17.0	26.5	20.0	16.5	20.1
F - Constant Speed	9	2100	18.0	18.0	15.0	17.5	34.0	23.0	18.0	27.0	23.0	20.0	21.4
G - Acceleration (40 hp @ 30 mph)	N	Start	69.0	49.0	43.0	31.0	27.0	39.0	51.0	61.0	47.0	54.0	46.9
	5	-	13.0	7.0	10.0	12.0	33.0	25.0	21.0	35.0	20.0	17.0	19.3
	6	-	22.0	10.0	16.0	18.0	37.0	26.0	19.0	32.0	20.0	15.0	21.5
	7	-	23.0	17.0	14.0	18.0	40.0	27.0	19.0	30.0	19.0	14.0	22.1
	8	-	26.0	17.0	13.0	16.0	45.0	28.0	18.0	31.0	20.0	15.0	22.9
	9	-	25.0	18.0	16.0	12.0	36.0	28.0	22.0	27.0	17.0	15.0	21.6
	10	-	27.0	13.0	29.0	17.0	35.0	31.0	24.0	32.0	22.0	18.0	24.8

(1) All constant speed smoke measurements made at maximum power output.

All idle-acceleration smoke measurements made at open rack with 32,000 lbs. inertia simulation.

than one-third the smoke produced by Series 5 (tractor 135), the unit which produced the highest smoke readings. This range of variability is not quite as great as that found for the ten buses studied which, as was pointed out, had a wider range of smoke than expected. Truck-tractor Series 2, 4, 7 and 10 also produced less than average smoke intensities under constant conditions as indicated by a comparison of the individual series results with the overall average value listed in the last column of Table 4, this text. The Series 5 tractor appeared to be a fairly smoky unit, and this was indicated by its substantially higher than average smoke levels. It is interesting to note that for practically all units tested, the smoke intensity decreased as the engine speed increased. In comparison with the ten-bus overall averages for steady state operation, the smoke from the four-cycle, number 2 fueled truck engine was somewhat greater than that of the two-cycle powered city bus operating on number 1 fuel. The apparent differences under constant type conditions were not as great as expected from the field studies. This lack of difference may be partially explained by the apparent greater smoke from the bus during the stringent dynamometer conditions relative to the appearance noted in the field under similar conditions. The difference did exist and would have been greater if bus smoke Conditon A, the 20-mph maximum power low engine speed condition, were discounted as previously mentioned. Comparing the results obtained from truck Conditions A, B, and C with truck Conditions D, E, and F, it is apparent that essentially equivalent smoke levels were obtained at equivalent engine speeds and that the effect of drive gear on smoke under constant speed operation was negligible.

The effect of acceleration through the drive gears, see Table 4 of this text, showed a marked effect on smoke production. As the vehicle speed increased, the amount of vehicle power absorbed increased in accordance with the "q" characteristic of the water brake dynamometer. This road load effect, in addition to the inertia of 32,000 pounds of vehicle weight, resulted in close simulation of an actual condition as determined in the field. Shown in Table 4, this text, are the smoke results for each vehicle series during each drive gear from 5th into 8th into 9th and into 10th (overdrive). As found in the field, the smoke intensity generally increased as the drive gear range increased. Not shown in Table 4 of this text but evident on the smoke traces, was the longer duration of these higher smoke intensities as the vehicle was operated in higher drive gears. A procedure has not been developed, however, to suitably weigh the smoke intensity for duration. Smoke emissions from the ten tractors under acceleration conditions indicated that the visible smoke plume intensity could vary widely. Series 2, tractor 129, produced the least overall amount, and Series 4, 10, 3, 9 and 7 were, in increasing intensity, all less than the ten-vehicle average. The acceleration smoke from Series 5, tractor 135, was almost three times as intense as Series 2 and was almost twice as intense as the overall ten-unit average. The PHS readings ranged from an average of 33 to 45-percent absorbance during the acceleration for Series 5, whereas the Series 2 readings ranged from 7 to 18-percent absorbance. In comparison with the bus transient smoke measurements at start of acceleration and on upshift, it may be reported that the tractor smoke was substantially more intense than the bus.

The final discussion of the Table 4, this text, smoke results is concerned with the constant speed and acceleration results considered together. It should be noted that, in actual practice, a truck engine rarely is operated under constant conditions for any appreciable length of time. Considering both types of operations, it is evident that Series 5, tractor 135, produced the highest smoke level. Series 2, 3, and 4 produced essentially identical smoke levels at the least end of the range. The Series 5 tractor smoke was slightly less than three times as great as the overall average of the ten tractors. From a review of the maintenance information given in Table 33, it appears that the number of miles since the last injector change and engine tune-up may have less effect on engine smoke output than is generally thought. The two units which produced the maximum and minimum smoke intensity, Series 5 and 3, respectively, had accumulated almost identical mileage of about 24,000 miles since the last injector change. These units, trucks 114 and 135, both White Freightliners, both in rental service, and both maintained by the same White distributor, produced significantly different levels of smoke. As in the bus situation, the injectors in tractor 135 may have deteriorated, while the injectors in tractor 114 may have remained in good condition. Based on the ten units evaluated, it is difficult to explain the variability found in smoke emissions by engine maintenance data alone.

In summary of the smoke portion of the vehicle variability study, the four-cycle diesel equipped truck-tractor, operating on a commercial number 2 fuel, resulted in higher smoke readings than the two-cycle powered city bus operating on a commercial number 1 fuel. The differences were substantially greater under transient, acceleration conditions than when the vehicles were evaluated under maximum power constant speed conditions. The variability of smoke intensity from the city bus was greater than expected; the most intense bus rating was over three times that of the least intense. The city bus acceleration results were somewhat less than some of the constant speed bus conditions. For the intercity tractor, however, the range of variability was such that the heaviest smoking tractor was less than three times that of the least intense tractor. The acceleration results of the tractors were generally greater tnan the constant speed conditions. From this brief discussion of truck smoke variability results, it is apparent that both constant speed and acceleration type conditions should be considered when measuring the visible smoke plume discharged from buses and particularly truck-tractors. It is evident that the constant speed tractor smoke conditions need to be investigated in only one vehicle drive gear, say 7th gear. Considering the bus and the truck odor and smoke measurements in light of the maintenance records, it seems apparent that vehicle maintenance alone, as measured by miles since the last injector change and tune-up or total engine mileage, may not have a satisfactory correlation to the resultant odor and smoke emissions.

C. Fuel Specifications

This subsection* covers the fuel specifications of typical commercial diesel fuels and limited inspections of the fuels used by San Antonio Transit System and Ryder Truck Leasing Company, suppliers of the bus and truck-tractor utilized in the field and procedural development studies. Table 5 lists typical diesel fuel marketing specifications for numbers 1 and 2 commercial fuel. These are the typical specifications under which San Antonio Transit and Ryder Leasing procure fuel for the two-cycle powered buses and four-cycle powered truck-tractors, respectively. Samples of fuels in use by San Antonio Transit and Ryder Leasing were obtained in March 1966, and selected properties determined. The results of these limited fuel inspections are listed in Table 6 for these samples. The distillation and sulfur data appear to be within specifications of Table 5.

For purposes of eliminating the possible effect of diesel fuel type and composition on the results of the procedural development and vehicle variability portions of this program, separate, 1000-gallon storage facilities were located adjacent to the Vehicle Emissions Laboratory chassis dynamometer facility. Using the specifications of Table 5, 1000 gallons each of numbers 1 and 2 fuel were obtained from Gulf Oil Company. The inspection data for samples of these reference supplies are listed in Table 7. The distillation data appear to be slightly lower overall than the typical specifications of Table 5. The cetane number or ignition quality of both fuels was about 2 cetane numbers lower than the typical specification of 46 and 52 for numbers 1 and 2 fuel. The greatest difference appears to be the total sulfur content which was higher than the previously analyzed samples (see Table 6) or the specifications of Table 5. The sulfur values of the fuels used for reference, however, were not considered excessive.

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*Tables 5, 6, and 7 referred to in this section, "V.C. Fuel Specification" are of this text and immediately follow.

TABLE 5. COMMERCIAL DIESEL FUEL SPECIFICATIONS - TYPICAL

Commercial Designation		1	2
Application		City Bus	Intercity Truck
Specification Provided by		S. A. Transit System	Ryder Leasing
Typical Supply		Gulf	Texaco
Property	ASTM Test Method No.	Typical Specifications	
Cetane	D613	46	52
Pour Point, °F	D97	-60	-10
Flash Point, °F	D93	133	182
Gravity, °API			36.7
Viscosity, SUS at 100°F	D445 D446	32	35.5
Carbon Residue (10% Res), %	D189	0.07	0.03
Total Sulfur, %	D129	0.04	0.08
Alkali or Mineral Acids	D663 or D664	0.03	
Water and Sediment	D96	0	
Distillation Range	D86		
Initial Boiling Point, °F		350	392
10% Point, °F			444
50% Point, °F			516
90% Point, °F		465	574
End Point, °F		518	610

TABLE 6. INSPECTION OF SAMPLE OF DIESEL FUEL USED BY RYDER LEASING AND SAN ANTONIO TRANSIT SYSTEM

Commercial Fuel Designation	1	2
Sample Information:		
Date Obtained	3/11/66	3/13/66
Source	S. A. Transit	Ryder Leasing
Date Analyzed	3/25/66	3/25/66
Code	EM-1-F	EM-2-F
Property		
Distillation Range		
Initial Boiling Point, °F	355	380
10% Point, °F	372	440
20% Point, °F	383	472
30% Point, °F	390	495
40% Point, °F	399	514
50% Point, °F	407	531
60% Point, °F	414	544
70% Point, °F	428	558
80% Point, °F	444	576
90% Point, °F	470	600
End Point, °F	512	624
% Recovery	97.5	97.0
% Residue	1.5	2.0
% Dist. Loss	1.0	1.0
F.I.A. Analysis		
Aromatics, %	14.7	12.4
Olefins, %	3.4	6.9
Saturates, %	81.9	80.7
Total Sulfur	0.036	0.077

TABLE 7. INSPECTION OF COMMERCIAL NUMBER 1 AND NUMBER 2 DIESEL FUELS USED IN PHS PROGRAM

Reference Fuel Number (Program Designation)	1	2
Commercial Fuel Type	1	2
Sample Information		
Code	EM-3-F	EM-10-F
Source	SwRI 1000-Gallon Supply	SwRI 1000-Gallon Supply
Date Analyzed	1/27/67	1/27/67
Property		
Distillation Range		
Initial Boiling Point, °F	326	320
10% Point, °F	360	398
20% Point, °F	372	424
30% Point, °F	380	456
40% Point, °F	388	472
50% Point, °F	396	488
60% Point, °F	404	504
70% Point, °F	414	518
80% Point, °F	428	536
90% Point, °F	450	557
End Point, °F	489	578
% Recovery	98.0	97.5
% Residue	1.8	2.2
% Dist. Loss	0.2	0.3
Cetane Number	43.7	49.5
F.I.A. Analysis		
Aromatics, %	15.2	19.5
Olefins, %	2.5	2.9
Saturates, %	82.3	77.6
Total Sulfur	0.09	0.11

VI. FUMIGATION STUDY

The objective of this phase was to explore the effect of fumigation on exhaust smoke using a Cummins NH 220 naturally aspirated four-cycle diesel engine. In general, fumigation consists of metering a small amount of fuel into the intake manifold of the engine to initiate precombustion reactions prior to and during the compression stroke. This causes a reduction in the ignition delay of the injected fuel, improves combustion, and ultimately results in either a power boost at equivalent injected fuel rates or a decrease in smoke at equivalent power levels with reduced injected fuel rates. These overall trends were reported by Dr. Paul H. Schweitzer, Jr., (Ref. 6) using diesel fuel as the fumigant in a single-cylinder CFR engine and by E. J. McLaughlin, P. L. Pinotti, and H. W. Sigworth (Ref. 7) who used fumigants such as the liquefied petroleum gases, butane and propane, and several easily vaporized gasolines.

On January 26, 1966 the planned fumigation of diesel engines was discussed with Dr. Paul H. Schweitzer, Consultant, at Southwest Research Institute. As a result of this day of consultation, it was tentatively determined that up to 15 percent of the injected fuel should be atomized as finely as possible in the intake of the Cummins NH 220 engine. Furthermore, it was mutually felt that the degree of success achieved in reducing exhaust smoke would be largely determined by how well the number 2 diesel fuel was atomized and vaporized in the engine intake air.

A. Equipment and Apparatus

By mutual agreement with the Project Officer, it was determined that fumigation should be investigated on the four-cycle Cummins NH 220 engine. Fumigation of the scavenged GM 6V-71 two-cycle engine could result in higher than normal unburned hydrocarbons which would tend to offset possible benefits with fumigation. The Cummins NH 220 engine utilized throughout the fumigation and dilution studies, reported in Section VII, was a used unit removed from an International Harvester model DC 405 cab-over truck-tractor. The specifications for this naturally aspirated, in-line six-cylinder, open combustion system engine are: bore 5-1/8 inch, 6-inch stroke, 743-cubic inch displacement, and rated load of 220 bhp at 2100-rpm engine speed. The used engine, with over 100,000 miles of truck operation, was installed in the stationary dynamometer laboratory in the same condition as removed from the tractor. The injectors were removed, inspected, and reworked to manufacturer's specifications by the local Cummins distributor. This engine utilized the Cummins PT injection pump.

The engine was installed on the test stand with a truck air cleaner and exhaust muffler--4-inch diameter stack configuration representative of normal truck-tractor installations. A 500-hp capacity dynamometer was used to absorb the output from this engine. Engine parameters of coolant in and out temperature, oil pressure and temperature, engine speed and horsepower, fuel consumption, etc., were routinely monitored. The dynamometer, engine speed, and other instruments and gages were calibrated prior to the fumigation and dilution studies. Smoke measurement was made exclusively with the PHS full-flow light extinction type smokemeter.

At the direction of the Project Officer, the fumigation study was limited to the use of commercial number 2 diesel fuel as the fumigant. The commercial diesel fuel used, referred to as Reference No. 2 diesel fuel, was previously described in Section V, Subsection C, Fuel Specifications. This fuel, the same as that normally injected in the engine, did not vaporize as easily as a gasoline or LP gas for example, and presented particular design and equipment problems. The success of the precombustion reactions in reducing smoke or increasing power depend greatly on how intimate the fumigant and the intake air become. Breaking the fuel into a fine mist or aerosol of 5 to 20-micron size, preferably less than 5 micron, followed by dispersion and mixing with the intake air flow prior to reaching the combustion chamber was the design objective. To meet this objective, a wide variety of fuel delivery and spray atomization systems was considered. These systems ranged from high pressure pulse injection used for fuel injection to low pressure Norgren type "mist-lubricators."

According to Dr. Schweitzer, a fumigant rate of 10 to 15 percent of the injected fuel rate was found optimum during the single-cylinder investigations. To accomplish the significant power increases or smoke levels reported in Reference 6 for the CFR laboratory engine, Dr. Schweitzer used a Norgren Micro-Fog pneumatic lubrication atomizer. This device, widely used in compressed air tool lubrication applications, was large enough to fumigate the CFR engine. Practical considerations, such as the 330 - 410 CFM NH 220 airflow at 1700 to 2100-rpm speed, precluded the use of a Norgren-type unit.

Following the SwRI study, including bench type spray/injection tests of alternative fumigation methods, two techniques were selected for investigation with the Cummins NH 220 engine. These methods were: (1) a pneumatic spray atomization using 50-psig compressed air to syphon No. 2 diesel fuel at a constant rate into an atomizing nozzle, and (2) a high pressure continuous fuel injection at 1100 psig via a Roosa-Master pencil-type fuel injector. The pneumatic spray atomization system was comprised of three Spraying Systems Company syphon type assemblies. Two of the assemblies consisted of a 1/4 J nozzle body with a No. 2850 air nozzle and No. 70 fuel nozzle. The third assembly comprised a 1/4 J nozzle body with No. 40100 air nozzle and a No. 122435 fuel nozzle. These nozzles, which consumed approximately 6 to 8 SCFM of air at 50 to 60 psig, were spaced around and located in the wall of the 5-gallon spray container previously described. As an alternative to the pneumatic system, a high pressure continuous injection system was designed and developed. This fumigation system was composed of a positive displacement metering type pump, fitted with an accumulator and connected to a Roosa-Master "pencil-type" injection nozzle No. XNM-60-1. Best spray pattern and penetration occurred at approximately 1100-psig delivery pressure. The pump was adjusted to maintain approximately 1500 to 2000 psig in the accumulator and to always deliver enough fuel to maintain a constant and continuous nozzle delivery. A needle valve between the accumulator tank and the Roosa injector nozzle permitted constant flow and constant nozzle pressure. For visual observation, the initial experiments with this system were conducted in the same 5-gallon spray container used in the pneumatic spray tests.

Following the successful development and engine evaluation of the two types of fumigation systems using the spray container, each was installed in the engine intake manifold. Figure 21 shows the location of each of the three Spraying Systems Company syphon type pneumatic atomization nozzles employed. Each nozzle fumigates two cylinders since cylinders 1 and 2, cylinders 3 and 4, and cylinders 5 and 6 each have a common intake air supply. The location shown was as near to the intake valves as possible. Atomizing air for each nozzle was supplied from a common 50-psig regulated laboratory source. Fuel supply was separate for each of the supply lines. Identical fuel flowmeters were utilized to monitor the fumigant flow rate. A further check and flow calibration were maintained by measuring the time for a known quantity of fuel to pass through the entire system.

Shown in Figure 22 is the high pressure continuous atomization fumigation system. This method, not as simple and inexpensive as the pneumatic system, involved spray injecting the total fumigant flow through a single injection nozzle assembly located in the intake manifold ell. This location was selected because it was the last single common manifold area in which the fumigant could become satisfactorily mixed with the intake air. It should be noted that, using either the pneumatic spray or high pressure spray, a portion of the mist or aerosol thus generated would coalesce into liquid droplets when the high velocity and turbulent intake airstream come in contact with a wall of the intake manifold or intake ports. Exactly what occurred to these fuel droplets in the intake manifold and their condition on passing the intake valve and entering the combustion chamber was not known.

B. Results

Tests of both fumigation systems were conducted initially with the delivery nozzles placed in a 5-gallon container mounted immediately adjacent to the engine intake manifold. Because of the experimental nature of this program, the initial step of spraying the fumigant into the 5-gallon container with a lift-off lid was employed in order to visually inspect the spray delivery during engine operation. The optimum system(s) determined during the spray container experiments was then installed in the engine intake manifold and its effect on smoke determined again.

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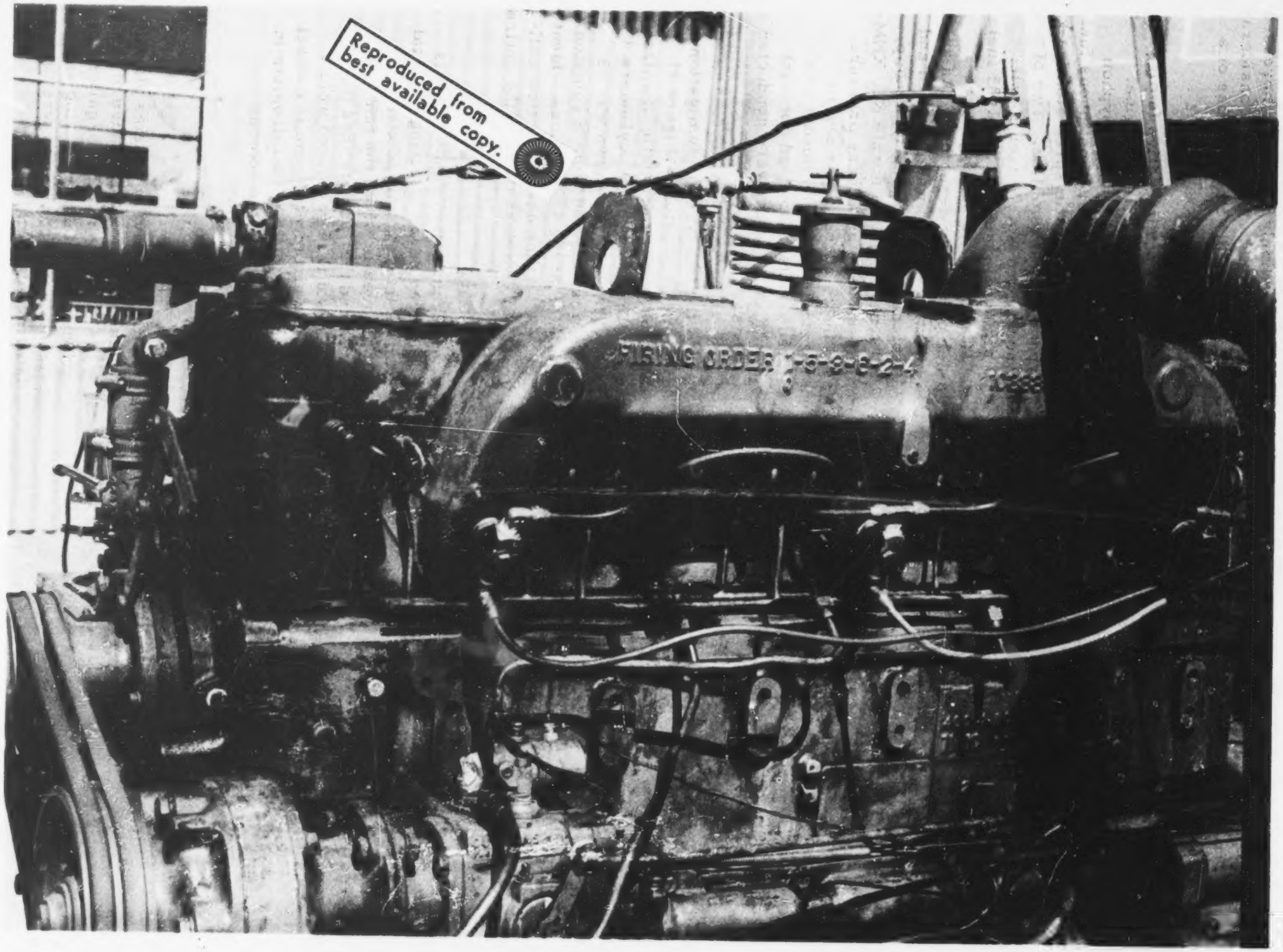

FIGURE 21. PNEUMATIC AND HIGH PRESSURE FUMIGATION SYSTEMS INSTALLED IN INTAKE MANIFOLD OF CUMMINS NH 220 ENGINE

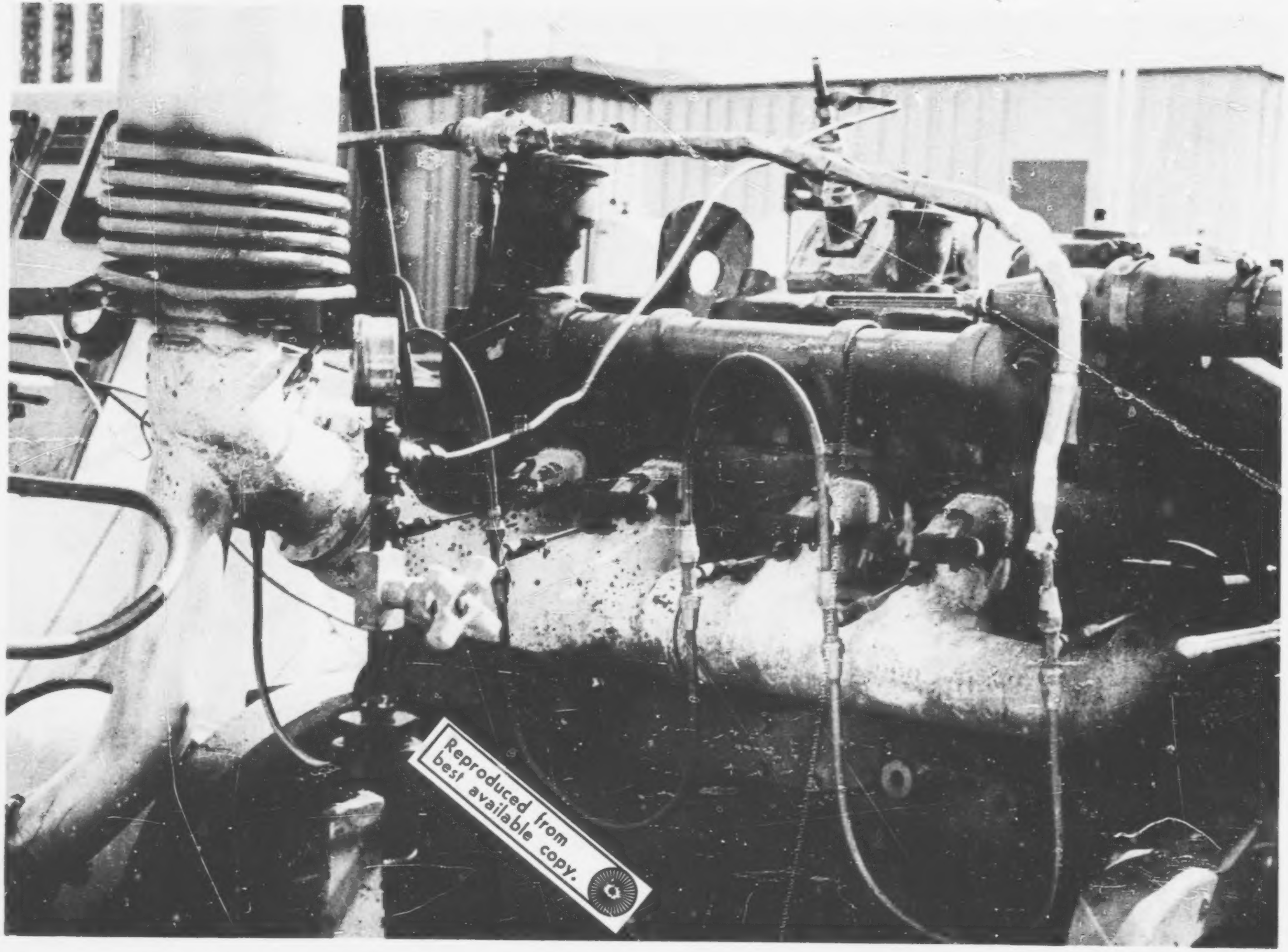

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FIGURE 22. HIGH PRESSURE FUMIGATION SYSTEMS AND EXHAUST MANIFOLD OXIDATION DILUTION SYSTEMS INSTALLED IN CUMMINS NH 220 ENGINE

1. Spray Container Experiments

The results of the fumigation experiments are included as Appendix G*. Tables 1 through 7 list the results obtained when fumigating by means of three pneumatic atomization nozzles located in the spray container. Tables 8 through 10 of Appendix G list the preliminary trials with a continuous high pressure liquid spray nozzle located in the spray container. Experiments summarized on Tables 1 through 5 were conducted with the engine fuel pump adjusted to result in a nominal maximum power smoke level of 10 percent via the PHS full-flow smokemeter, which was used exlusively during these studies. It should be mentioned that the fuel delivery pressure to the injectors from the Cummins PT pump could be altered by removing or adding shims under a nylon plunger within the pump. Using this technique to slightly derate and underfuel the engine, a wide variety of pneumatic atomizing spraying systems could be evaluated in the search for hardware configurations optimized for maximum power boost and minimum smoke increase. These preliminary tests resulted in the selection of the three Spraying Systems Company syphon type assemblies previously described.

The Table 1 data indicate that use of the pneumatic atomizing system could result in a 6 to 9-percent increase in engine power output under open rack maximum power conditions. The exhaust smoke, however, increased up to 80 percent over the initially light 10 to 12-percent absorbance condition. This set of runs indicated, however, that fumigation could improve the brake horsepower output of the NH 220 engine. It should be noted that the No. 2 diesel fuel was fumigated at a rate of approximately 13.6 to 15.4 percent of the calculated injected fuel rate. Calculated fuel consumption, based on an average 0.4 pound fuel per brake horsepower hour specific fuel consumption, was initially employed and was verified by later fuel consumption measurements. Table 2 lists the first noticeable improvement in exhaust smoke with fumigation under equivalent engine power levels with and without fumigation. The procedure followed during these and all following equivalent power runs was to first operate the engine without fumigation at maximum power open rack and record the smoke reading. The engine rack was then partially closed to give about a 50-percent reduction in smoke, and fumigation was begun. The rack setting and dynamometer load were then adjusted to the same speed and load as obtained during the open rack nonfumigating initial condition. The smoke level was once again recorded and compared. The series of experiments listed in Table 2 indicates little or no improvement in smoke at the fumigation rate of 13.3 to 15.4 percent of the calculated open rack injected fuel rate.

Tables 3 and 4 are similar to Tables 1 and 2, respectively, except the fumigant rate was reduced from 10.3 to 9.5 pounds per hour by means of needle valves located in the spray nozzle fuel supply lines. For the decreased fumigation rate of 12.2 to 14.2 percent of the open rack engine fuel consumption, similar power improvements (and smoke increases) at open rack or equivalent smoke at equivalent power levels were obtained.

In conversation with Dr. Schweitzer, it was recalled that, in order to be effective on smoke, fumigation should be applied only at full rack, maximum power, under heavy smoke conditions. A quick and adjustable method (but by no means a recommended or approved way) to increase power and smoke on some fuel injection systems is to restrict the injector fuel return line by a suitable needle valve. It should be noted that a few truck drivers pinch the return line to obtain increased smoke and power from their truck-tractor. Listed in Table 5 are the results of a series of experiments conducted with and without fuel return line restriction to indicate the significant effect that 40 psig of injector backpressure has on power and smoke. For example, at 1700-rpm engine speed, engine power was increased 31 hp, and exhaust smoke increased from 7 to 34-percent absorbance. Under these heavier smoke conditions, the rack was reduced and fumigation applied with the net result of a 24-percent reduction in smoke at 1700 rpm at a constant 198-hp output.

With these mostly encouraging results, the engine fuel pump was adjusted to deliver sufficient fuel to result in a moderately heavy smoke level at open rack throughout the 1700 to 2100-rpm engine speed range of interest. The results of this series of experiments are contained in Table 6. It is interesting to note that as engine speed was increased from 1700 to 2100 rpm, the smoke readings decreased from 35 to 26-percent absorbance. In addition, the fumigation of approximately the same percentages of normal injected fuel had less and less effect as the engine speed was increased and the base engine smoke decreased. This was apparently a characteristic of the NH 220 test engine as it was consistently observed on numerous similar experiments.

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*All of the tables called out in this section, "VI. B. Fumigation Study," are presented in Appendix G.

To investigate further the effect fumigation rate had on smoke reduction, a series of tests was made during which the rack was adjusted to result in a constant power output of 192 hp at 1700 rpm and 213 hp at 1900 rpm. First, the fumigant rate was increased slowly from 6.8 to 23.5 percent of the measured open rack fuel consumption at 1700 rpm. The smoke reductions effected varied with fumigant rate as shown in Table 7. For both the 1700 and 1900-rpm engine speed conditions reported, the optimum smoke improvement was noticed at approximately 11-percent fumigation or 9.65 pounds per hour. Again, the maximum smoke reduction at 1700 rpm was approximately twice that at 1900-rpm engine speed.

. A series of high pressure continuous fumigation experiments was then combined. These tests were also made using the spray container so that the success of the spray atomization under open rack, maximum power engine operation could be visually monitored. Tables 8, 9, and 10 summarize the results of these tests at 7, 10 and 13.6 pounds per hour fumigant delivery rate, respectively. Considering these three tables together, the high pressure spray method is indicated to reduce smoke at equivalent power outputs. The percent smoke reduction decreased with increased engine speed and decreased nonfumigated engine smoke. Similar to the pneumatic spray system results, the optimum fumigant rate for smoke reduction appeared to be about 11 percent of the open rack, normal fuel consumption of the engine.

2. Intake Manifold Experiments

The results of the application of the two fumigation systems to the intake manifold of the NH 220 engine are discussed in the following paragraphs. The preliminary screening and exploratory type investigations, conducted with fumigation occurring in the spray container, permitted application of proven hardware systems. Table 11, Appendix G, lists the results obtained from fumigating via the pneumatic spray system mounted in the intake manifold. A range of engine speeds from 900 to 2250 rpm was investigated and the resultant smoke levels recorded at equivalent power output. The operating procedure was to first operate under maximum power nonfumigating conditions and record the power absorbed and smoke emitted. Then the rack was partly closed to give about 50-percent reduction in smoke. Fumigation was then begun and the rack adjusted to produce the same power output previously recorded. The smoke level was then recorded and compared to the initial reading.

As shown in Table 11, the effect of fumigation on exhaust smoke ranged from a minimum of 60 percent to a maximum reduction of 80 percent at low engine speeds of 900, 1100, and 1300 rpm. However, as engine speed increased, the beneficial effect decreased until at 2250 rpm, slightly below maximum governed rpm, no reduction in smoke was measured. These experiments, conducted at several fumigant rates, also indicate that approximately 6 to 11 percent of the normally injected fuel flow was the optimum fumigant rate. It should be reported that it was possible to over fumigate and cause combustion noise, knock, and detonation to occur. The 80-percent improvement in exhaust smoke at 900 rpm and at approximately 11-percent fumigation rate practically repeated the results obtained by Dr. Schweitzer (Ref. 6), who reported smoke reductions up to 80 percent with a single cylinder prechamber type four-cycle CFR research engine operating only at a constant 900 rpm. It was important in this study to try and ascertain if the fumigation equipment and system was capable of delivering the fumigant in a finely divided atomized mist to the engine. Since all attempts at the normal 1700 to 2100-rpm engine operating range had resulted in 30-percent reduction or less, operation at the lower speeds, especially at 900 rpm, was desired. In addition to adequate fumigation of the fuel, residence time of the fumigant in the combustion chamber, as evidenced by engine speed, appeared to have as great or even greater an affect on exhaust smoke.

Tables 12, 13, and 14 list the results of experiments with the high pressure system. Fumigation was effected at the ell above the intake manifold via single continuous high pressure fuel injector. The method of engine operation was identical to that previously described except, prior to each series of runs, the injector would be removed and the system adjusted to fumigate at t desired rate with satisfactory spray penetration and atomization. Accordingly, the results of Table 12 were obtained at a fumigant rate of approximately 2.5 pounds per hour and Tables 13 and 14 at 6 and 10 pounds per hour, respectively. Considering the percent smoke improvement obtained during all three series of tests, Tables 12 through 14, it is apparent that high pressure fumigation effected smoke in nearly the same way as the pneumatic system. The smoke reduction decreased with decreased fumigant residence time (increased engine speed) but was effective at low speeds of 900 to 1300 rpm. The optimum fumigant delivery rate appeared to range from 5 to 12 percent of the base nonfumigated engine fuel consumption. In summary, it appears that both fumigation systems do result in decreased engine exhaust smoke of the Cummins NH 220 engine evaluated. The improvements recorded, however, can only be classed as a partial or technical success in that significant reductions in visible smoke were obtained only at engine speeds far below those normally used in commercial engine operation.

Although fumigation does not seem to be capable of satisfactory smoke reduction, it may be that variations of the basic fumigation principle could permit significant smoke reductions in modern high speed engines. One such recent variation to the fumigation system was described in a recent automotive news article (Ref. 8) in which the fumigated fuel was atomized and partially oxidized in a small reactor. Only a fraction of the total engine airflow passes through this reactor, where it is heated sufficiently to force partial oxidation but not cause ignition and combustion. This flow of partially oxidized fuel and air mist then mixes with the usual engine intake air prior to being swept into the combustion chamber. On the basis of a single-cylinder laboratory engine study, this system was reported to reduce smoke or improve power by reducing the ignition delay of the injected fuel. This or a similar system might minimize or eliminate the engine speed, combustion residence, effect on smoke reduction. To develop and adopt such a system for a full-scale engine of the NH 220 size would require months of dynamometer work.

VII. DILUTION STUDY

The purpose of this phase was to study several exhaust dilution techniques to determine their effectiveness in reducing smoke and possibly odor. Dilution of the exhaust, defined as adding outside air to the exhaust prior to its exit from the exhaust stack or tailpipe, may be accomplished by a variety of ways.

A. Equipment and Apparatus

A full-scale, widely-used four-cycle engine mounted on a stationary test bed was exclusively employed during the study of exhaust dilution. The engine was the same six-cylinder, naturally aspirated, Cummins NH 220 engine used during the fumigation study previously described. Please refer to Section VI for engine specifications, special preparations, and installation details. As in the other phases of the program, smoke measurement was made exclusively with the PHS full-flow light extinction smokemeter.

Before describing the dilution system apparatus, it should be reported that there are numerous articles, papers, and literature about diesel engine smoke, its formation, control, measurement, etc. Of the three basic types of black, blue, and white diesel smoke, only black smoke was encountered during these studies with the Cummins NH 220 engine. Exhaust gas quenching/cooling is the generally accepted mechanism that converts the mostly incandescent, white hot, practically invisible, carbon particles as they pass from the combustion chamber of a well-operated engine under maximum power conditions to the typical black smoke emission in the atmosphere. On some trucks operating at near maximum heat, fuel, and load conditions, it is interesting to notice that the exhaust remains practically invisible up to sometimes one or even two inches above the top of the exhaust stack before assuming the familiar black appearance. Based on exhaust gas quenching, numerous alternative dilution systems were considered for treatment of the exhaust between the exhaust valves and the atmosphere. Of the various methods studied, three representative techniques based on the desire to investigate dilution of the exhaust at various points in the exhaust system were selected for initial test and evaluation. The three systems involved: (1) introducing a low flow of air at an exhaust valve underhead, (2) admitting a high flow of outside air to the exhaust between the exhaust manifold and the muffler, and (3) modifying the appearance of the exhaust at the exit of the stack.

The exhaust manifold oxidation system developed and evaluated on the NH 220 engine is shown on Figure 22. Note the individual 3/16-inch stainless oxidizing air supply tubes protruding from each exhaust port of the three cylinder heads. These supply tubes extend through the wall of the exhaust manifold and bend down so that the exit of the tubes was within approximately 1/4 inch from the exhaust valve underhead. The six tubes were manifolded together and supplied by air preheated by passage through approximately 20 feet of 1/2-inch diameter copper tube coiled about the base of the exhaust muffler. The surge air tank shown on the table in Figure 23 was employed to permit the supply of a steady regulated quantity of compressed shop air. The flow, precalibrated with an ASME thin plate orifice, was controlled by adjusting the supply manifold pressure from 5 to 30 psig.

The next representative exhaust dilution system is also shown, in part, in Figure 23. This system employed a high-speed pressure blower, not shown, to force outside air into the exhaust. The blower was sized to deliver up to 100 percent of the engine exhaust flow at pressures in excess of the maximum exhaust manifold outlet back pressure. The dilution air was admitted to the exhaust at the sweep ell which connects the muffler-exhaust stack to the exhaust manifold outlet. The blower discharged into a 4-inch diameter duct shown in the foreground of Figure 23. A 3-inch valve regulated the flow of dilution air into the 3-inch outlet welded into the 4-inch ell. A pitot tube was used to monitor the airflow in the 4-inch supply duct.

The third method involved the study and test of a method to modify the exhaust appearance at the exhaust stack outlet. Rather than design and fabricate a suitable item for this portion of the study, an exhaust dilution device was located for evaluation from Charles Morris, President of Versatile Engineering, Los Angeles, California. The principle of design was to discharge the usual 4-inch diameter exhaust flow from a thin vertical slot. In passing through the device, the geometry

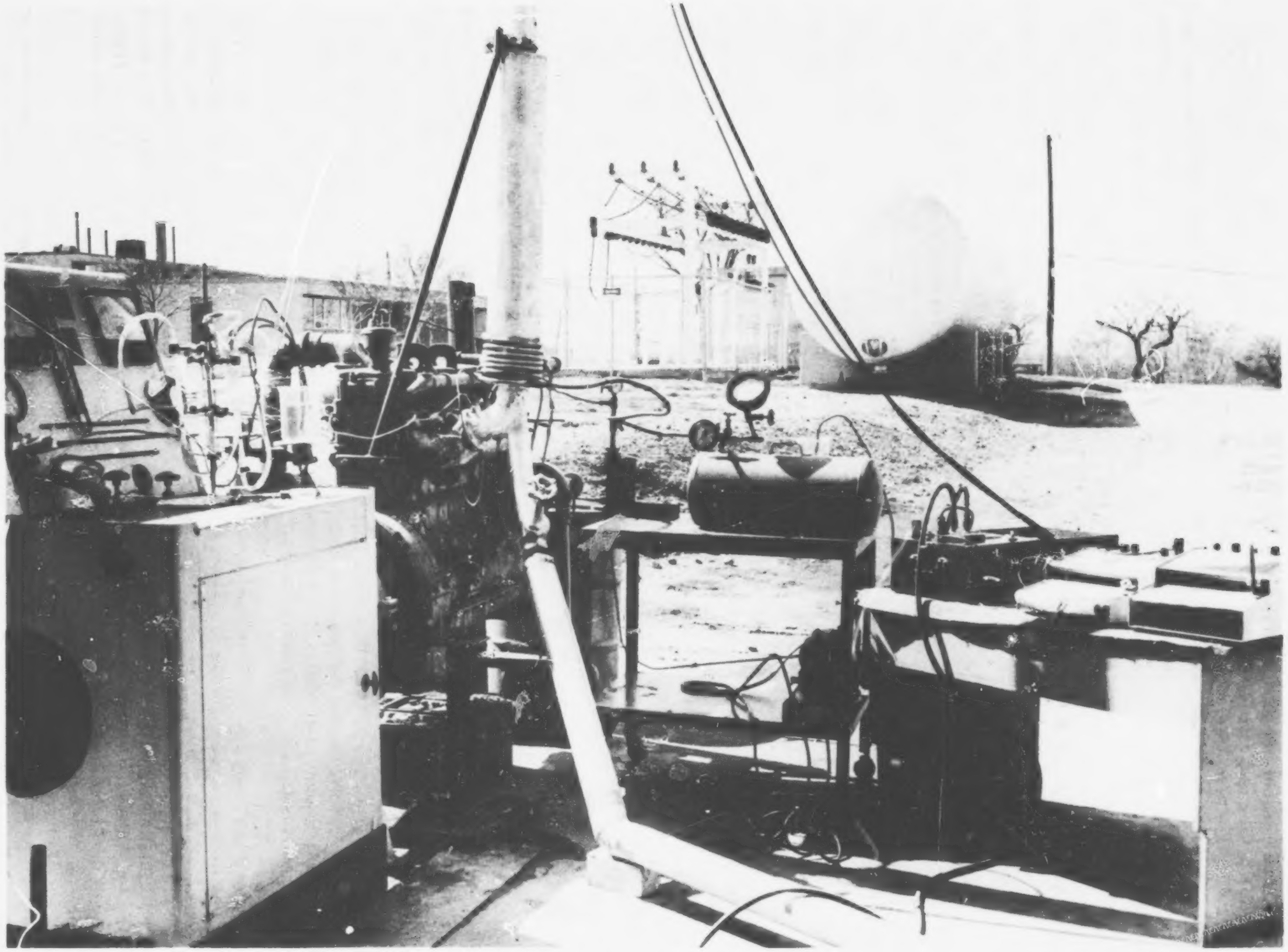

FIGURE 23. PARTIAL VIEW OF FUMIGATION AND DILUTION EXPERIMENTAL EQUIPMENT WITH CUMMINS NH 220 ENGINE

was designed to permit outside air to be induced and, if traveling at sufficient road speed, be rammed into the device and mixed with the exhaust prior to its exit. After considerable study and consideration of this interesting and unique invention, it was determined that the device was a well-designed and fabricated item and was selected as the third representative dilution technique.

B. Results

The results of the evaluations performed on the three different representative exhaust dilution methods are described in the following paragraphs. These evaluations were limited to the Cummins NH 220 engine previously described.

1. Manifold Air Introduction System

The results of the evaluation of exhaust dilution by adding air to the exhaust as it exited the combustion chamber are listed in Tables 1 and 2 of Appendix H*. It should be noted that the Cummins NH 220 engine has two intake and two exhaust valves per cylinder and that the dilution air was added at the exhaust valve nearest the exhaust manifold. The initial and exploratory results of Table 1, Appendix H, indicate that this dilution technique was almost as effective in reducing visible smoke as fumigation which was reported in Section VI throughout the 1700 to 2100-rpm engine speed range of primary interest. The effect of this technique on smoke was more immediate than fumigation and, for the initial set of experiments, appeared to be slightly better at the instant the air was first introduced than after a few seconds. The smoke produced during these experiments, at constant speed and maximum power, was measured by the PHS smokemeter. This smokemeter, which is highly responsive to slight changes in engine operation and resultant smoke variation, permitted rapid and continued indication of the effects of time as well as dilution flow rate on exhaust smoke. It is interesting to note that at 1700 rpm engine speed, smoke reductions up to approximately 30 percent were obtained at an exhaust dilution less than 10 percent of the base engine exhaust flow rate. With these mostly successful results obtained during the initial series of experiments, further investigation appeared warranted. As the dilution studies progressed, it became evident that this system of introducing less than 25 SCFM of air into the exhaust was not merely diluting the exhaust but was providing additional oxygen for continued oxidation of the incandescent carbon particles. The technique seemed to function in a manner similar to the manifold oxidation systems employed by major automakers to meet California requirements for carbon monoxide and unburned hydrocarbons. The automotive systems, however, consume considerably more air than the diesel system evaluated. Additionally, manifold oxidation of a diesel should not, in theory, reduce exhaust smoke because, unlike the spark ignited, throttled, automotive engine, the diesel engine is unthrottled and always operates with excess air in the combustion chamber. The diesel engine, however, operates under heterogeneous air-fuel mixtures due to fuel injection, etc., and this accounts somewhat for exhaust smoke during maximum fueling and maximum power operation of some engines. This occurs even though the air/fuel ratios are seldom less than 20:1 overall, and the engine is operating with gross excess air. It may be that, during the highly turbulent discharge of the exhaust from the combustion chamber, the small amount of air introduced does permit some additional oxidation of the carbon before its exit from the engine with correspondingly less visible smoke.

The results of a similar series of experiments conducted over the 900 to 2250-rpm speed range of the engine are listed in Table 2. These experiments were conducted at a variety of manifold oxidation flows from 6 SCFM to 21 SCFM which, depending on engine speed and exhaust flow, resulted in dilution levels of 1 to 13 percent of the base engine exhaust flow. In order to take advantage of a possible benefit of preheated air on oxidation, these trials were made with hot oxidizing air. The air was preheated by passing it through a copper tubing coil at the base of the exhaust muffler previously illustrated. This heat exchanger was not particularly efficient but did seem to help somewhat. The results of Table 2 indicate that as engine speed was increased from 900 rpm to 2250 rpm, the percent improvement in visible smoke increased overall to an apparent maximum of 23 percent at 1700 rpm. At speeds of about 1700 rpm, the smoke improvement, though slight, remained fairly constant at between approximately 10 to 15 percent. The increased effectiveness of the manifold oxidation system with engine speed may be related to the increased temperature of the exhaust gases on exit from the combustion chamber. This trend was opposite to the previously reported effect of fumigation on exhaust smoke with engine speed. Of primary interest, however, was the effectiveness of manifold oxidation at the 1700 to 2100-rpm engine speeds normally encountered during routine truck operation. Although the 10 to 15-percent smoke improvements were consistent, the results of this system can only be termed a technical success. Even if the smoke improvement was doubled due to technique development, this minimal reduction may not justify the expense of the equipment and the air compressing unit.

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*All of the tables called out in this section, "VII. B. Dilution Study," are presented in Appendix H.

Although this system appears to have a limited application for smoke reduction, the technique of further oxidizing diesel engine exhaust by manifold injection has been preliminarily explored and established. It may be somewhat easier to oxidize some of the odorous constituents of two-cycle diesel engine exhaust and thereby modify the characteristic two-cycle engine diesel odor. The exhaust temperature of the supercharged, scavenged, GM 6V-71, two-cycle engine widely used in municipal buses is lower than that from the Cummins NH 220, four-cycle engine. This approach toward further oxidation of a few partially oxygenated odorous materials may permit odor reduction in addition to a slight reduction in visible smoke.

2. High Flow Dilution System

As shown in Figure 23, this system involved adding outside dilution air to the engine exhaust at the sweep elbow connecting the exit of the exhaust manifold and the inlet to the exhaust muffler-stack assembly. These tests, all at open rack, maximum power conditions, involved measuring the exhaust smoke at a variety of dilution airflows. Sufficient laboratory tests were obtained to demonstrate that this method of exhaust dilution was mostly ineffective in reducing visible smoke. Considering the investigated range of 900 to 2250 rpm, the percent smoke improvements, at equivalent dilution levels of approximately 50 percent of the base engine exhaust flow, resulted in a smoke reduction of approximately 5 to 15 percent. Greater improvements, noticed at 900 rpm, were obtained by adding up to 200-percent dilution. Throughout the 1700 to 2100-rpm engine range of primary interest, the results of dilution via this technique were mostly discouraging in that the improvement tended to decrease with increased engine speed similar to the results with fumigation. These results represent only a limited and technical success for this system and, therefore, do not appear to warrant continued investigation.

One tentative explanation for the apparently dismal level of success for this method of exhaust dilution may be that merely diluting by physically quenching the exhaust does nothing to reduce the mass of carbon particles. The effect of dilution on the visual appearance of the plume was also studied using the PHS smoke inspection guide (Ref. 9). Except for the highest dilutions at 900, 1300 and 1700-rpm engine speed, the visual differences, if any, were difficult to measure.

It should be pointed out that high dilution levels of say 80 to 100 percent of normal exhaust flow will be difficult to obtain in the Cummins NH 220 type engine without increasing the exhaust piping and muffler systems from the normal 4-inch diameter stack to approximately a 5-inch diameter. At the normally used engine speed of 1700 to 2100 rpm, introduction of an additional 200 to 400 CFM to the approximately 300 to 400 CFM of discharged exhaust will increase the engine backpressure in many truck exhaust systems above the maximum recommended 1.5 inches of mercury.

3. Stack Tip Exhaust Dilution

Shown in Figures 24 and 25 are photographs of the smoke plumes with and without the stack dilution unit from the Cummins NH 220 engine under identical conditions. These photographs were obtained in an attempt to show that the stack tip dilution unit, a typical and well-made exhaust dilution device, had little if any effect on the visible smoke discharge. Although the exhaust smoke from the device was discharged through a vertical slit which when viewed from the side appeared less, the plume tended to reestablish a few feet to the left of the stack and looked as intense as that from the modified PHS equipped stack in Figure 25. Visual comparison was made throughout the range of 900 to 2250-rpm engine speed at maximum power, open rack operating conditions by means of the PHS smoke inspection guide. The results of these visual smoke ratings are listed in Table 4

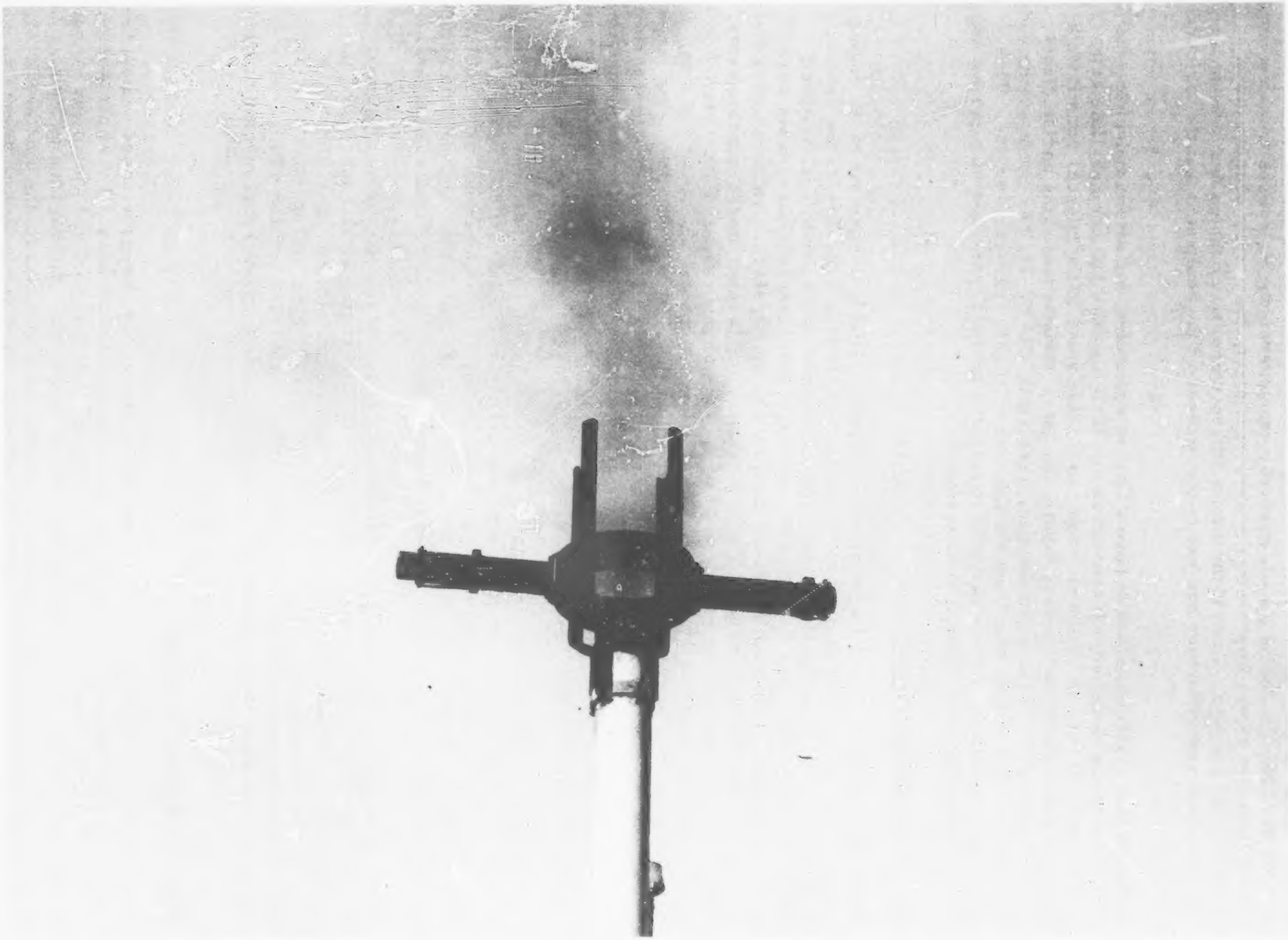

FIGURE 24. HEAVY SMOKE CONDITION MEASURED BY PHS SMOKEMETER
(CUMMINS NH 220 ENGINE)

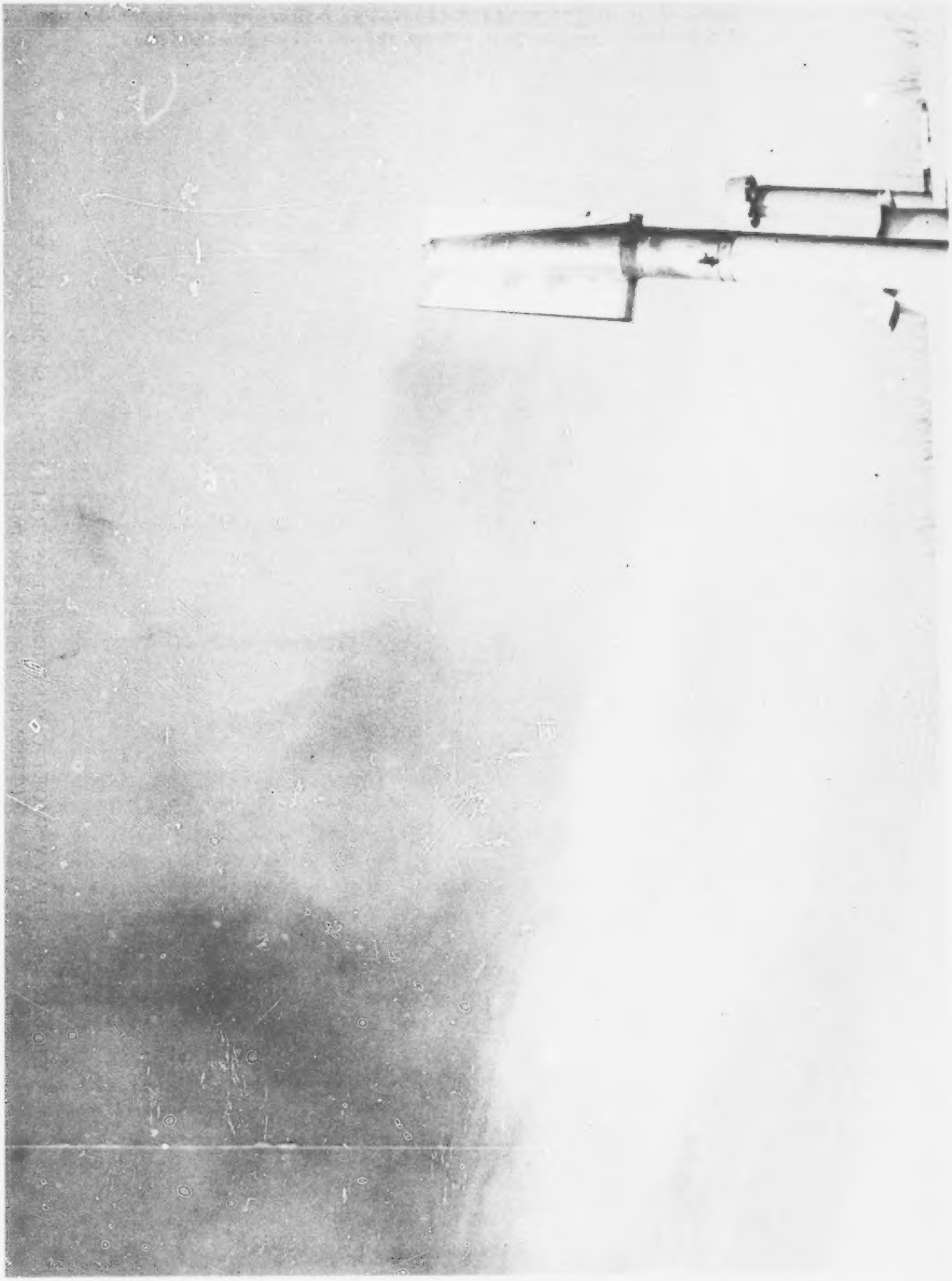

FIGURE 25. EVALUATION OF AN EXHAUST DILUTION DEVICE
(CUMMINS NH 220 ENGINE)

and indicate that the stack tip exhaust dilution device had little effect on visible smoke. The reason for the lack of success was probably due to the quenching effect of the diluted air on the exhaust. In addition, merely splitting the exhaust or discharging the exhaust as a thin vertical layer did not appear satisfactory in reducing the visible smoke plume from the diesel engine tested.

VIII. SUMMARY

The following is a brief summary of the pertinent results of this investigation of diesel powered city bus and intercity truck odor and smoke:

(1) During the field studies, operating conditions which produced significant levels of odor and smoke were identified for the city bus and truck under a variety of typical driving and traffic situations. It was found that the two-cycle powered city bus emitted noticeably greater levels of odor than the four-cycle powered truck, but the visible smoke plume was more evident from the truck than the bus. Significant bus odor-producing conditions included an idle followed by full rack acceleration, several constant speed cruise conditions, and deceleration after cruise. The truck smoke conditions involved open rack, maximum fueling, power conditions at constant speed and during acceleration through the ten-forward-speed transmission.

(2) Atmospheric exhaust dilution was also studied to determine what typically occurs to diesel exhaust in the atmosphere and to obtain an idea of what a person in a car or standing on the curb experiences. These surveys, conducted with a newly developed trace gas technique, included both a city bus with horizontal exhaust discharge and a tractor-trailer truck with a vertical exhaust stack. These surveys indicated that reasonable dilution ratios behind and beside a city bus might range between 100:1 and 1000:1. For the vertical discharge from a truck with a 40-foot long van type trailer, the survey results indicated that typical dilution ratios behind and beside the truck could range from 700:1 to 7000:1. It was also found that exhaust system configuration, among many other factors, could have an influence on consequent dilution of the exhaust in the atmosphere.

(3) Since measurement of vehicle odor and smoke under realistic conditions with the Public Health Service developed smokemeter and odor quality/intensity evaluation kit was unprecedented, a completely new facility was required. A facility was specially designed to permit the measurement of smoke and odor under simulated road conditions using full size city buses or tandem axle truck-tractors. The odor facility was designed and constructed to permit the simultaneous measurement of a dilute sample of diesel exhaust by a panel of ten women. This facility, unique in the nation, involved automatic exhaust gas sampling and dilution, rapid transfer of the diluted sample to the odor room and continuous availability for evaluation by the odor panel. Special precautions were taken to maintain an odor free constant temperature and humidity room environment in a pleasant, sound-insulated panel room. To provide samples of exhaust odor and smoke from vehicles under road-like conditions involved the design, fabrication, and installation of a modified tandem axle chassis dynamometer capable of absorbing 200 hp/axle and a system capable of simulating the inertia of a 25,000-pound city bus or a 32,000-pound truck.

(4) Using the results from the field studies of significant smoke and odor producing conditions and atmospheric exhaust dilution, the measurement facilities were employed to develop evaluation techniques. The field studies and laboratory facilities permitted realistic simulation of actual road conditions in the laboratory. From a number of operating conditions, dilution levels, etc., a series of five odor conditions was selected; odor panel and laboratory testing procedures were also developed. These conditions involved both idle, idle-acceleration, constant speed, and deceleration operation typical of city bus operation. Both constant speed and acceleration smoke measurement procedures were developed for the bus using the PHS full flow smokemeter. Six odor-producing conditions, including several constant speed and several transient modes of operation, were determined for the four-cycle powered truck-tractor. These conditions were selected from a wide variety of possible vehicle speeds and loads, engine speeds, and dilution ratios as representative of normal highway truck operation. Smoke measurement procedures included both transient acceleration and

steady state cruise conditions. The procedures thus developed were based on substantial laboratory and odor panel effort.

(5) The study of vehicle variability, involving ten similar trucks and ten similar buses, revealed that the smoke and odor from these vehicles may have a fairly broad range of variability. The odor from the ten two-cycle powered city buses varied from an average low of [illegible].3 to an average high of 7.8 as indicated by the "D," the diesel composite responses. This difference of approximately [illegible].5 in the intensity scale can be considered as the highest level bus odor, being approximately ~~five~~ three times as intense as the lowest level. Compared to the four-cycle powered truck-tractors evaluated, the level of exhaust odor from the ten buses was significantly higher than that from the trucks. Only a part of this difference could be attributed to the different dilution ratio of 100:1 for the bus exhaust versus 700:1 for the truck exhaust. This sevenfold increase in dilution did not account for the gross difference in two-cycle versus four-cycle odor as indicated by the sixteenfold difference in "D" diesel composite ratings. These differences were also shown by some of the four quality standards in addition to the overall composite. Notable was the wide difference in the "B" Burnt-Smoky ratings of the bus exhaust as compared to the truck. It was this quality which was most obvious in the dilution samples of bus exhaust, and it accounted for most of the comments involving harshness of the odor in terms of its penetrating, lasting, and sometimes nauseating character. The variability of smoke intensities from the ten buses evaluated was greater than expected, the most intense exhaust smoke being about three times that of the least intense. The variability of the truck exhaust smoke was less than that for the bus. The smoke intensity from the truck, operating on number 2 diesel fuel, was greater than the smoke measured from the number 1 fueled city bus vehicle. The difference in the truck versus bus smoke intensities was not as great as expected and may possibly be attributed to the stringent 20-mph open rack, maximum powered, bus condition in which the engine was operated at low speed. A review of the maintenance records for both the ten buses and trucks failed to reveal any obvious explanation for the smoke and odor variation obtained.

(6) A limited study of fumigation, a method for reducing smoke by introducing some diesel fuel into the intake manifold, resulted in only a partial or technical success. This experiment, conducted in a stationary operated Cummins NH 220 four-cycle engine, indicated that the effectiveness of fumigation was an exceptional 50 to 80-percent reduction at low engine speeds of 900 to 1300 rpm under heavy smoking conditions. But, at engine speeds normally operated such as 1700 to 2100 rpm, the percent smoke improvement was relatively minor. It was found that as engine speed was increased, the effectiveness of fumigation decreased from a 30-percent reduction at 1700 rpm down to less than 5-percent reduction at 2250 rpm. The single-cylinder, CFR engine results at 900 rpm, reported by Dr. P. H. Schweitzer, an advocate of fumigation, were demonstrated in the multicylinder NH 220 engine. Residence time of the fumigant within the cylinder and combustion chamber appeared to limit the usefulness of fumigation in modern high-speed diesel engines.

(7) Another possible method for reduction of exhaust smoke, exhaust gas dilution, was studied using three representative dilution techniques. These systems involved (a) introducing a low flow of air at an exhaust valve underhead, (b) admitting a high flow of outside air to the exhaust between the exhaust manifold and muffler, and (c) modifying the appearance of the exhaust at the exit of the stack. Evaluations of the three methods by means of the Cummins NH 220 truck engine indicated that only a limited smoke reduction was possible with methods (a) and (b). The method (c) stack dilution device was found to have no noticeable effect on visible smoke. Method (a), a version of exhaust manifold oxidation employed by certain automakers for California-sold automobiles, is superior to the high flow system method (b) and may have limited success with the GM 6V-71 two-cycle bus engine in reducing smoke and odor.

IX. CONCLUSIONS AND RECOMMENDATIONS

Based on the work performed during this program, the following conclusions and recommendations are offered for consideration:

(1) This program has produced sufficient survey data on smoke and odor intensities for two widely used diesel powered vehicles, i.e., the GM 6V-71 two-cycle powered municipal bus and the Cummins NH 220 four-cycle powered truck tractor. Other vehicles such as four-cycle municipal buses, intercity two- and four-cycle buses and other light and heavy duty trucks should be less extensively evaluated to provide a total survey of odor and smoke levels and operating conditions.

(2) Continuation and expansion of the atmospheric dilution surveys are recommended based on the conclusion that the vertical exhaust stack, characteristic of the truck-trailer, apparently was more successful in diluting the exhaust in the atmosphere than the normal horizontal rear exhaust discharge of municipal buses. The influence of exhaust discharge velocity, direction of discharge, flow rate, and location of exhaust system are all factors that warrant additional investigation.

(3) Although the odor and smoke measurement facility functioned satisfactorily during the procedural development and vehicle variability studies, continued refinement and modification should be considered when the need occurs. One such facility improvement that is recommended is the addition of equipment to control the absolute humidity of the exhaust sample diluent air. This refinement will eliminate a variable that possibly may affect the odor quality/intensity evaluation by the human panel. Consideration of a constant, regulated, 6-volt DC power supply for use with the PHS full flow smokemeter is also recommended to minimize the slight zero drift experienced with use of wet cell batteries.

(4) The successful application of the procedures developed for the one type of city bus and one type of truck-tractor indicates that those procedures are satisfactory for the two diesel powered vehicles included. The procedures, developed for the vehicle variability studies, however, should be further simplified and refined by reducing the number of conditions, number of repeat measurements and, where possible, use of simpler, less costly simulation equipment. It is recommended that other types of buses and trucks be investigated and the procedures generalized to cover essentially all commercially used vehicles. Alternative road simulation methods, as well as odor measurement techniques, should be investigated to determine if simplified approaches can be developed.

(5) Based on the operating conditions used during this study, the two-cycle GM 6V-71, E series engine produced significantly greater odor than the truck-tractor powered by a four-cycle, Cummins NH 220, naturally aspirated, diesel engine. This difference in odor intensity and quality is felt substantial enough to justify major future emphasis being placed on the odor emissions from two-cycle powered vehicles. The results of the smoke variability measurements indicate that the GM 6V-71 powered city buses produced somewhat less smoke using number 1 fuel than the Cummins NH 220 powered truck-tractor operated on number 2 fuel. These differences were not considered substantial enough to justify discontinuing smoke measurements from the two-cycle unit. It is recommended that the entire vehicle variability data and results be subjected to a statistical analysis as soon as practical.

(6) Based on the results of the study of fumigation in a four-cycle Cummins NH 220 engine, it is concluded that fumigation with number 2 diesel fuel does not effectively reduce the smoke from this modern medium high-speed diesel engine. Accordingly, it is recommended that this technique for reduction of visible exhaust smoke not be considered for further development.

(7) The results of the study of several types of exhaust dilution methods likewise indicate only a limited effectiveness. Based on the full-scale NH 220 engine tests, it is recommended that consideration of this approach to smoke reduction from this type of engine be discontinued. It is further recommended that a preliminary investigation be made of a Detroit Diesel, two-cycle, 6V-71 powered, GM city bus suitably modified for the manifold oxidation system. This technique, partially successful in reducing four-cycle exhaust smoke, may be equally successful in modifying a few of the odorous materials exhausted from the two-cycle engine.

In addition to the aforementioned conclusions and recommendations made as a result of this program, other, possibly more important, needs have become evident. There is a continuing and immediate need for a suitable physical-chemical method to permit satisfactory measurement of diesel exhaust odor in both the field and laboratory. Such a technique would greatly extend the usefulness of the human odor panel and permit odor measurement by additional industrial and government laboratories. Present efforts to correlate wet chemical and instrumental exhaust gas measurements with the human panel response should be continued and, where advisable, accelerated. Particularly recommended is a substantial research program to develop a simple technique(s) which may be easily and quickly employed to evaluate the quality and intensity of diesel exhaust odor.

Finally, the diesel smoke and odor effort to date has been devoted to field studies of operating conditions and atmospheric dilution, facility and procedural development, study of vehicle variability, and an investigation of two proposed techniques for smoke reduction. The odor data thus obtained have been in terms of odor qualities and intensities per the PHS Q/I kit and smoke density or absorbance per the PHS full flow smokemeter. Eventually, this and future similar data should be related to what the general public feels and says regarding diesel powered vehicle odor and smoke. To relate the laboratory measurements to the general public reaction, a comprehensive field survey is recommended. Such a survey should have as its objective the determination of public objectionability to various levels of diesel exhaust odor and smoke under simulated realistic conditions. This survey should involve a statistically significant number of participants from a number of cities across the United States. It is felt this study will greatly enhance and extend the usefulness to the U.S. Public Health Service of the laboratory odor and smoke data determined during this and future similar programs.

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APPENDIXES

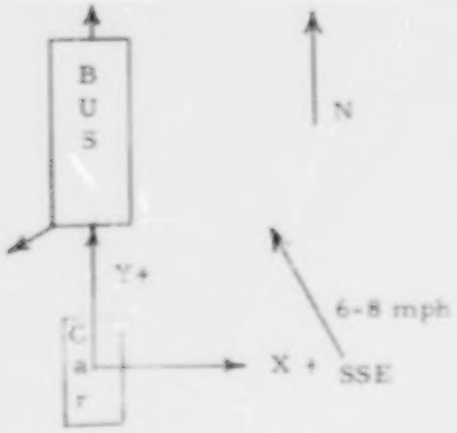
A. Initial Road Odor and Smoke Measurements
B. Atmospheric Exhaust Dilution Results
C. Laboratory Odor and Smoke Procedural Development Results
  (Municipal Bus)
D. Laboratory Odor and Smoke Procedural Development Results
  (Truck-Tractor Powered by Four-Cycle Diesel Engine)
E. City Bus Variability Results
  (GM 6V-71, Two-Cycle Engine)
F. Intercity Truck-Tractor Variability Results
  (Cummins NH 220, Four-Cycle Engine)
G. Phase F Fumigation Results
  (Cummins NH 220, Four-Cycle Engine)

APPENDIX A

INITIAL ROAD ODOR AND SMOKE MEASUREMENTS

Table 1. INITIAL ROAD ODOR AND SMOKE STUDIES WITH SMALL PANEL

(Vehicle and Car Moving)



Vehicle: Bus 695, A/C on

Sample Location: 4-Man Panel in Car Behind Bus, All Windows/Vents Open

Weather: 94°F, 56% RH, Wind 6-8 MPH out of SSE, steady

Route: Loop 410, Access Roads, and Nearby Country Roads

Vehicle Direction	Vehicle Speed MPH	Type of Road	Panel in Car Behind Bus Y (ft)	Average Odor Intensity	Average Smoke Intensity
W	0	Level	20	1.0	1.0
	10	Level		2.5	0.3
	20	Uphill		2.5	0.5
	30	Level		2.0	0
E	10	Uphill		1.0	0
	10-20 acc	Level		2.0	2.0
	20	Level		2.0	0
	20-30 acc	Downhill		2.5	2.3
	30	Level		1.7	0
	30-40 acc	Downhill		2.5	2.2
	40	Level		2.3	2.3
	40-30 dec	Level		1.0	0
	30	Uphill		1.5	2.0
	30-20 dec	Level		1.3	0
	20	Uphill		2.0	2.3
	Rt turn acc	after dec	10	1.5	2.5
S	10	Level	20	1.0	0
	20	Level	40	1.0	0

Note: Car always behind bus, X = 0
acc means acceleration
dec means deceleration

Table 1. INITIAL ROAD ODOR AND SMOKE STUDIES WITH SMALL PANEL Page 2
(Vehicle and Car Moving)

Vehicle Direction	Vehicle Speed MPH	Type of Road	Panel in Car Behind Bus Y (ft)	Average Odor Intensity	Average Smoke Intensity
S	20-30 acc	Level	40	2.0	3.0
	30	Level		1.8	2.0
	30-40 acc	Level		1.5	3.0
	40	Level		2.3	2.0
	40-0 dec	Level		3.5	0.5
	0-10 acc	Level		2.5	1.0
	10	Level		1.3	0
	10-20 acc	Uphill		2.5	2.0
	20	Level		1.0	0
	0-20 acc after	Idle		3.0	3.0
	20	Uphill		1.3	0
	20-10 dec	Level	20	1.6	0
	10-20 acc	Level		2.6	2.6
N	20-10 dec	Level	20	0	0
	10-30 acc	Uphill		2.7	2.9
	30	Level		1.7	0
	30-40 acc	Level		2.3	3.0
	35	Uphill		2.0	2.0
	40	Downhill		1.2	2.0
	40-0 dec	Level		1.7	0
	0-20 acc	Level		1.8	2.7
	35	Level		2.0	2.3
	40	Level	40	1.5	1.3
	40-10 dec	Level		0.7	0
	10-30 acc	Level		0.7	3.7
	20	Level		0.7	0
	20-40 acc	Level		1.7	3.0
	40-0 dec	Level	20	1.0	0
	0-30 acc	Level		2.7	2.7
	30	Level	40	1.3	0
	30-40 acc	Level		1.5	2.7
	30	Uphill		1.5	2.7
	30-0 dec	Uphill		1.0	0
	0-10 after idle	Uphill		3.0	3.3
	10	Downhill	20	1.3	0

Table 1. INITIAL ROAD ODOR AND SMOKE STUDIES WITH SMALL PANEL

(Vehicle and Car Moving)

Vehicle Direction	Vehicle Speed MPH	Type of Road	Panel in Car Behind Bus Y (ft)	Average Odor Intensity	Average Smoke Intensity
N	10	Uphill	20	3.3	2.0
	10-20 acc	Level		2.0	0.3
	20	Level	20	2.0	0
	20	Uphill		2.7	1.7
	20-30 acc	Level		2.7	3.0
	30	Level		2.0	3.0
	30	Downhill		2.7	0
S	0-20 acc	Uphill	20	3.0	3.0
	20	Uphill		2.7	1.7
	20	Uphill		3.7	2.0
	20-30 acc	Level		2.6	3.0
	30	Uphill		2.3	2.7
	30	Level		1.8	0
	30	Uphill		1.5	3.0
	30	Downhill		4.0	0
	20	Uphill		2.0	3.3
	20-0 dec	Downhill		1.0	0
	0-20 acc after idle	Level		2.0	1.8
	20	Level		1.7	0
	20	Downhill		1.0	0
	20	Level	40	1.7	0
	20-30 acc	Level		2.7	3.0
	30	Level		1.0	1.0
	0-20acc after long idle	Level	20	4.0	4.0
	20	Level		2.7	0.8
	20-30 acc	Level	50	2.5	3.0
	30	Level		1.0	0
	30-40 acc	Level		2.3	3.0
	35	Level		1.7	2.3
	35	Level		0.7	2.0
	40	Level		1.3	1.3
	40-10 dec	Level		2.7	0
	0-10 acc left turn	Level		4.0	1.0

Table I. INITIAL ROAD ODOR AND SMOKE STUDIES WITH SMALL PANEL Page 4
(Vehicle and Car Moving)

Vehicle Direction	Vehicle Speed MPH	Type of Road	Panel in Car Behind Bus Y (ft)	Average Odor Intensity	Average Smoke Intensity
N	10-30 acc	Level	50	1.0	2.0
	40	Level		1.3	1.3
	45 sustained	Level		3.0	1.0
	40	Level		1.7	1.0
	40-0 dec	Level		3.0	0
	0-30 acc	Level		1.7	1.7
	30-35 acc	Level		0.7	1.0
	40	Level		1.3	1.0
	40-0 dec	Level		1.7	0
	0 (Idle)	Level	20	0	0
	0-25 acc	Level	50	1.3	2.2
	45	Downhill		1.7	1.0
	40	Level		1.3	1.3
	40	Level		1.7	1.0
	45	Downhill		2.3	2.0
	45-0 dec	Level		2	0.3
	0-30 acc after idle	Level		2.7	2.0
	30	Level		2.3	0.3
	20 in high range	Uphill		3.0	3.0
	20	Level		0.7	0.3
	20	Uphill		3.0	1.7
	20-10 dec	Level		0.7	0
E	0-20 acc after idle	Level	50	3.0	2.0
	20-0 dec	Downhill		3.0	0
	0-10 acc after idle	Level		2.5	1.0
	5-10 acc	Level		3.7	1.7
	10	Uphill		2.7	0.7
	0-10 acc after idle	Level		2.7	1.0
	10-0 dec	Level		0.7	0
	0-20 acc	Level		2.7	1.7
	20 (low range)	Uphill		3.0	0.7
	20	Downhill		1.0	0
	20	Uphill		1.3	0.3
	45	Uphill		2.3	1.0
	45-0 dec	Uphill		1.0	0.3

Table I. INITIAL ROAD ODOR AND SMOKE STUDIES WITH SMALL PANEL Page 5.

(Vehicle and Car Moving)

Vehicle Direction	Vehicle Speed MPH	Type of Road	Panel in Car Behind Bus Y (ft)	Average Odor Intensity	Average Smoke Intensity
Air Conditioning turned "Off"					
S	0-30 after long idle	Level	50	3.7	3.3
	30	Uphill		1.7	2.7
	30-40 acc	Level		2.3	1.7
	40	Level		1.0	2.0
	40-50 acc	Downhill		3.3	2.7
	30-0 dec	Level		0	0
	0 (Idle)	Level		0.3	0
	0-30 acc	Level		2.7	2.9
	45	Level		2.0	2.0
	40	Level		1.0	1.3
	40-0 dec	Level		3.0	0
	0-30 acc	Level		3.0	2.0
	30-40 acc	Level		1.7	3.0
	35	Level		1.7	2.0
	35-20 dec	Level		4.0	0
	20-30 acc	Level		1.3	3.3
	30	Level		1.0	2.0
	35	Level		2.0	2.0
	35-0 dec	Level		3.0	0
	0 (Idle)	Level		0	0
	0-35 acc	Level		2.0	3.0
	0-35 acc after idle	Level		2.8	2.7
	30	Uphill		2.0	2.7
	40	Level		2.8	2.7
	40	Uphill		2.8	2.0
	40-10 dec	Level		2.0	0
	10	Uphill		1.3	0.7
	10	Downhill		0.3	0
	10-20 acc	Level		1.3	2.0
N	40	Level	20	3.3	2.0
	40-0	Level	30	2.7	0
	0-30	Level	50	2.7	2.0
	35	Level	50	2.0	1.7

Table 1. INITIAL ROAD ODOR AND SMOKE STUDIES WITH SMALL PANEL Page 6.

Vehicle Direction	Vehicle Speed MPH	Type of Road	Panel in Car Behind Bus Y (ft)	Average Odor Intensity	Average Smoke Intensity
N	40	Level	50	1.7	1.7
	40-20 dec	Level	50	2.7	0
	20-30 acc	Level		1.7	3.3
	20-40	Level	20	2.3	2.7
	45	Downhill		2.7	1.7
	35	Level		2.3	1.7
	35	Uphill		2.7	2.0
	10	Level	20	2.0	1.0
	10	Uphill		3.0	0.2
	15	Uphill		4.0	0.3

Table 2. SUMMARY OF TABLE 1 INITIAL ROAD DATA

(Odor)

Basis: All conditions which resulted in an average odor intensity rating of 3.0 or greater

Vehicle Direction	Vehicle Speed MPH	Type of Road	Distance Behind Bus, Ft.	Average Odor Intensity
S	40-0 dec	Level	40	3.5
	0-20 acc after idle	Level	40	3.0
	0-20 acc	Uphill	20	3.0
	20	Uphill	20	3.7
	30	Downhill	20	4.0
	0-10 acc left turn	Level	50	4.0
	0-30 acc after long idle	Level	50	3.7
	40-50	Downhill	50	3.3
	40-0 dec	Level	50	3.0
	0-30 acc	Level	50	3.0
	35-20 dec	Level	50	4.0
	35-0 dec	Level	50	3.0
N	0-10 acc after idle	Uphill	40	3.0
	10	Uphill	20	3.3
	45 sustained	Level	50	3.0
	40-0 dec	Level	50	3.0
	20	Uphill	50	3.0
	40	Level	20	3.3
	10	Uphill	20	3.0
	15	Uphill	20	4.0
E	0-20 acc after idle	Level	50	3.0
	20-0 dec	Downhill	50	3.0
	5-10 acc	Level	50	3.7
	20	Uphill	50	3.0

Note: acc means acceleration
dec means deceleration

Table 3. SUMMARY OF TABLE 1 INITIAL ROAD DATA

(Smoke)

Basis: All conditions which resulted in an average smoke intensity rating of 3.0 or greater

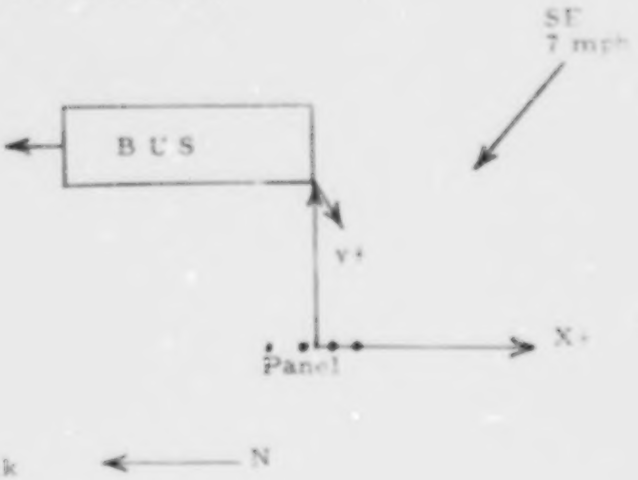
Vehicle Direction	Vehicle Speed MPH	Type of Road	Distance Behind Bus	Average Smoke Intensity
S	20-30 acc	Level	40	3.0
	30-40 acc	Level	40	3.0
	0-20 acc after idle	Level	40	3.0
	0-20 acc	Uphill	20	3.0
	20-30 acc	Level	20	3.0
	30	Uphill	20	3.0
	20	Uphill	20	3.3
	20-30 acc	Level	50	3.0
	0-20 acc after long idle	Level	20	4.0
	20-30 acc	Level	50	3.0
	30-40 acc	Level	50	3.0
	0-30 acc after long idle	Level	50	3.3
	20-30 acc	Level	50	3.3
	0-35 acc	Level	50	3.0
N	30-40 acc	Level	20	3.0
	10-30 acc	Level	40	3.7
	20-40 acc	Level	40	3.0
	0-10 acc after idle	Uphill	40	3.3
	20-30 acc	Level	20	3.0
	30	Level	20	3.0
	20 (high range)	Uphill	50	3.0
	20-30 acc	Level	50	3.3

Note: All accelerations are uphill operation at full rack.

Note: acc means acceleration
dec means deceleration

Table 4. INITIAL ROAD ODOR STUDIES WITH SMALL PANEL

(Vehicle Moving, Panel Stationary)



Vehicle: Bus 695, A/C On

Sample Location: 4-Man Panel Standing on Curb

Weather: 92°F, 44% RH, Wind out of SE at 7 mph, steady

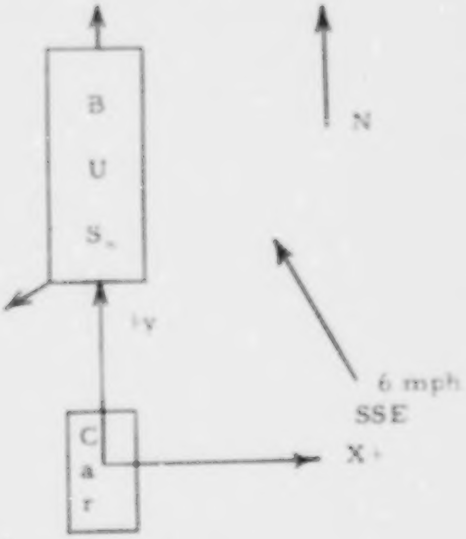
Route: Residential - 1 minute Idle followed by Full Rack Acceleration

Sample Rated at (Feet from bus)		Average Odor Intensity	
X	Y	Idle	Accelerative
0	15	1.0	3.7
0	15	0.7	4.0
- 18	15	2.0	3.7
- 18	10	2.0	2.8
- 18	20	2.5	3.8
- 36	15	0.8	3.7
- 36	25	1.5	2.8

Note: Average intensities of exhaust odor high due to 7 mph wind blowing the vehicle exhaust directly into panel.

Table 5. INITIAL ROAD ODOR STUDIES WITH SMALL PANEL

(Vehicle and Car Moving)



Vehicle:	Bus 695, A/C on
Sample Location:	4-Man Panel in Car behind Bus, All Windows/Vents open
Weather:	92° F, 51% RH, Wind 6 MPH from SSE
Route:	North-South on level Loop 410 Access Roads Constant Speed Conditions

Run Direction	Vehicle Speed MPH	Sample Obtained at (Feet from Bus) X	Y	Average Odor Intensity Constant Speed
N	30	0	20	2.5
N	20	0	20	3.2
S	20	0	20	3.0
S	20	0	20	2.2
S	40	0	10	3.0
S	20	0	20	2.5
S	20	0	20	2.8
S	10	0	20	3.0
N	5	0	30	2.7
N	15	0	40	2.0
N	30	0	40	2.8
N	30	0	40	2.5
N	5	0	10	0.8
N	5	0	30	1.0
N	5	0	20	2.2
N	30	0	30	1.5
N	35	0	30	2.8

Table 5. INITIAL ROAD ODOR STUDIES WITH SMALL PANEL Page 2.

(Vehicle and Car Moving)

Run Direction	Vehicle Speed MPH	Sample Obtained at (Feet from Bus)		Average Odor Intensity Constant Speed
		X	Y	
S	20	0	30	3.5
S	30	0	40	2.0
S	40	0	10	3.5
S	20	0	50	3.5
S	10	0	10	2.0
S	10	0	20	3.2
S	10	0	30	3.3
S	50	0	25	1.5
S	30	0	30	2.5
S	30	0	30	3.0
S	50	0	20	3.8
S	50	0	10	4.0
S	50	0	30	3.25
S	40	0	50	1.0
S	50	0	50	2.0
S	50	0	50	2.5

Table 6. INITIAL ROAD ODOR STUDIES WITH SMALL PANEL

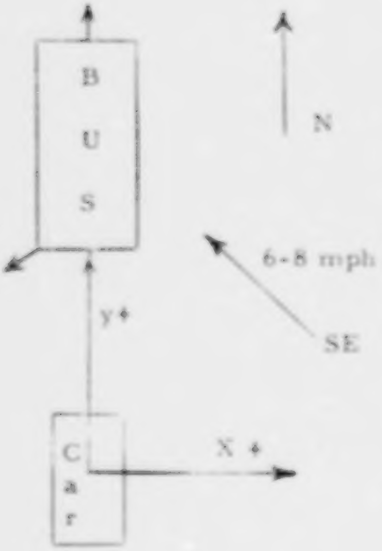
(Vehicle and Car Moving)

Vehicle: Bus 695, A/C On

Sample Location: Four-man Panel in Car Behind Bus All Windows/Vents Open

Weather: 89°F, 55% RH. Wind from SE, 6-8 MPH

Route: North-South on level Loop 410 Access Roads. Idle for 1 minute followed by full rack acceleration to 40 MPH and then Closed Rack deceleration to 0 MPH



Run Direction	Sample Obtained at (Feet from Bus) X	Sample Obtained at (Feet from Bus) Y	Average Odor Intensity Idle	Acceleration	Const Speed	Deceleration
S	0	20	1.2	2.7	2.0	1.8
S	0	20	3.	2.8	2.5	3.5
N	0	30	2.5	3.0	2.0	2.5
N	0	30	2	3.5	2.5	N. D.
S	0	30	1.2	3.5	2.7	1.8
S	0	30	1.2	3.0	2.8	3.0
N	0	20	1.2	3.0	2.3	3.5
N	0	20	0.7	2.7	3.0	2.7
S	0	20	1.5	3.5	3.2	3.8
S	0	20	1	3.5	2.5	3.5
N	0	40	1.2	3.0	2.0	3.5
N	0	40	0.2	3.0	2.0	3.3
S	0	40	0.7	2.8	3.0	2.0
S	0	30	0.2	3.5	2.3	3.7
N	0	50	0.2	2.5	1.8	3.0
N	0	50	0.2	2.8	2.5	3.8
E	0	20	1.7	2.5	2.2	3.3

Table 7. SUMMARY OF TABLE 6 INITIAL ROAD ODOR STUDIES

(Vehicle and Car - Panel Moving)

Basis: All idle, acceleration, constant speed and deceleration odor ratings averaged at each of the various distances from the bus, regardless of run direction.

Distance Feet From Bus		Average Panel Odor Intensity			
		Idle	Acceleration	Constant Speed	Deceleration
20	Maximum	3.0	3.5	3.2	3.8
	Minimum	0.7	2.5	2.0	1.8
	Average	1.6	3.0	3.0	3.1
30	Maximum	2.5	3.5	2.8	3.7
	Minimum	0.2	3.0	2.0	1.8
	Average	1.5	3.3	2.4	2.7
40	Maximum	1.2	3.0	3.0	3.5
	Minimum	0.2	2.8	2.0	2.0
	Average	0.8	2.9	2.3	2.9
50	Maximum	0.2	2.8	2.5	3.8
	Minimum	0.2	2.5	1.8	3.0
	Average	0.2	2.6	2.1	3.4

Table 8. INITIAL ROAD ODOR STUDIES WITH SMALL PANEL

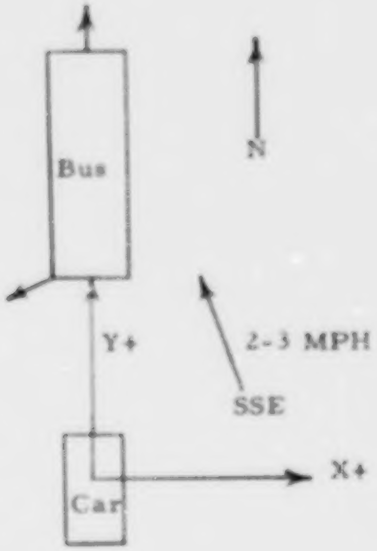
(Vehicle and Car Moving)

Vehicle: Bus 695 with A/C On

Sample Location: 4 Man Panel in Car Behind bus, all windows and vent open

Weather: 93° F, 34% RH Slight 2-3 mph breeze out of SSE

Route: North-South on level loop 410 access roads. Idle for 1 min. followed by full rack acceleration to speed indicated and then closed rack deceleration to 0 MPH



Run Direct	Vehicle Speed MPH	Sample Obtained (Feet from Bus) X	Sample Obtained (Feet from Bus) Y	Average Odor Intensity Idle	Average Odor Intensity Acceleration	Average Odor Intensity Const Speed	Average Odor Intensity Deceleration
S	0	0	20	0.7			
	0 - 20		20		2.9		
	20		10			1.2	
			20			1.8	
			30			1.8	
			20				2.0
S	0	0	20	1			
	0-25		20		3.3		
	25		10			2.2	
			20			1.7	
			30			1.0	
			40			0.8	
		+10	10			0.2	
			20			0	
			20				1.3

Table 8. INITIAL ROAD ODOR STUDIES WITH SMALL PANEL (Page 2)

(Vehicle and Car Moving)

Run Direct	Vehicle Speed MPH	Sample Obtained (Feet from Bus) X	Y	Average Odor Intensity Idle	Acceleration	Const Speed	Deceleration
S	0	0	20	1.1			
	0 - 30		20		3.3		
	30		20			2.3	
			30			1.8	
			40			0.9	
		-10	20			0	
			30			1.8	
			20				2.0
	30 - 0	0	20				2.5
S	0	0	20	0.7			
	0 - 35		20		3.2		
	35		10			1.3	
			20			2.5	
			30			2.0	
		-10	10			0.7	
	35 - 0		30				3.3
S	0	0	20	0			
	0 - 45		20		3.2		
	45		20			1.7	
			30			2.4	
			40			2.3	
	45 - 0		30				4.0
With Bus Air Conditioner "On"							
N	0	0	20	0			
	0 - 30		30		2.3		
	30		20			1.7	
			30			2.2	
			40			1.2	
			50			0.8	
	30 - 0		30				3.5

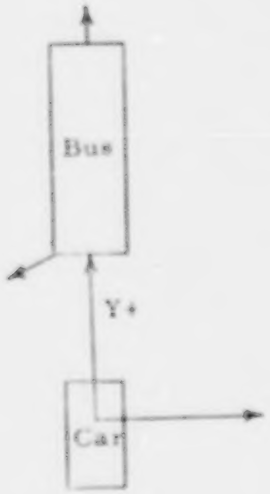
Table 8. INITIAL ROAD ODOR STUDIES WITH SMALL PANEL (Page 3)

(Vehicle and Car Moving)

Run Direct	Vehicle Speed MPH	Sample Obtained (Feet from Bus)		Average Odor Intensity			
		X	Y	Idle	Acceleration	Const Speed	Deceleration
S	0	0	20	0.5			
	0 - 35		30		3.3		
	35		20			3.2	
			30			2.9	
			40			2.3	
			50			1.3	
	35 - 0		30				3.7
N	0	0	20	0			
	0 - 45		20		3.0		
	45		20			2.3	
			30			2.0	
			40			1.7	
			50			1.3	
			60			0.8	
	45 - 0		30				3.9

Table 9. DOWNTOWN INITIAL ROAD ODOR STUDIES WITH SMALL PANEL

(Vehicle and Car Moving)



Vehicle	Bus 695 with A/C On
Sample Location	4 Man Panel in Car Behind Bus, all windows and vents open
Weather	74° F, 89% RH Calm, No Wind
Route	Downtown Driving Patterns as Shown in Fig. 1 of Appendix B

						Average Odor Intensity			
Run Pattern	Curb Lane	Vehicle Speed MPH	Feet Behind Bus, Y	Direction of Bus		Idle	Accel	Const Speed	Deceleration
Right	Right Curb	15	15	Straight	Maximum	0.5	3.0	3.3	3.5
					Minimum	0.5	1.5	1.5	1.0
					Average	0.5	2.4	2.3	2.1
				Right Turn	Maximum		3.0		
					Minimum		1.0		
					Average		1.8		
Left	Left Curb	15	15	Straight	Maximum	1.0	2.5	2.0	
					Minimum	0.5	2.0	1.4	
					Average	0.8	2.2	1.7	1.5
				Left Turn	Maximum		3.7		
					Minimum		3.3		
					Average		3.6		
Right	Right Curb	15	10	Straight	Maximum	1.7	4.0	2.5	2.0
					Minimum	0.5	2.0	1.0	1.0
					Average	0.9	2.7	1.8	1.5

Table 9. DOWNTOWN INITIAL ROAD ODOR STUDIES WITH SMALL PANEL (Page 2)

(Vehicle and Car Moving)

Run Pattern	Curb Lane	Vehicle Speed MPH	Feet Behind Bus, Y	Direction of Bus		Average Odor Intensity			
						Idle	Accel	Const Speed	Deceleration
				Right Turn	Maximum		3.0		
					Minimum		1.0		
					Average		1.9		
Left	Left Curb	15	20	Straight	Maximum	0.5	4.0	2.5	1.0
					Minimum	0.5	2.3	1.5	0.5
					Average	0.5	2.9	2.0	0.7
				Left Turn	Maximum		4.0		
					Minimum		3.0		
					Average		3.5		
Right	Right Curb	20	20	Straight	Maximum	1.5	4.0		0.7
					Minimum	0.3	1.2		0.5
					Average	0.7	2.8	1.8	0.6
				Right Turn	Maximum		3.0		
					Minimum		2.3		
					Average		2.7		
Left	Left Curb	20	20	Straight	Maximum	2.0	3.5	3.0	2.3
					Minimum	0.5	2.0	2.0	0.5
					Average	1.3	3.0	2.5	1.6
				Left Turn	Maximum		4.0		
					Minimum		3.5		
					Average		3.8		
Right	Center	15	20	Straight	Maximum	1.0	4.0	2.5	2.0
					Minimum	0.5	2.0	1.5	0.7
					Average	0.7	2.6	2.0	1.3
				Right Turn	Maximum		3.0		
					Minimum		2.0		
					Average		2.5		

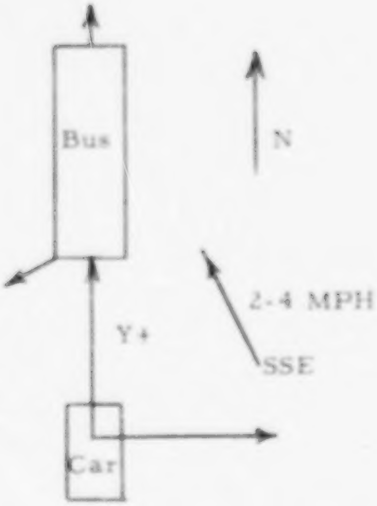
Table 9 DOWNTOWN INITIAL ROAD ODOR STUDIES WITH SMALL PANEL (Page 3)

(Vehicle and Car Moving)

Run Pattern	Curb Lane	Vehicle Speed MPH	Feet Behind Bus, Y	Direction of Bus		Average Odor Intensity			
						Idle	Accel	Const Speed	Deceleration
Left	Center	15	20	Straight	Maximum	1.0	2.6	2.5	
					Minimum	0.5	1.8	1.3	
					Average	0.8	2.1	1.8	1.0
				Left Turn	Maximum		4.0		
					Minimum		0.5		
					Average		2.3		
		15	10	Straight	Maximum			3.0	
					Minimum			2.5	
					Average			2.8	
Sampling Car in Center Lane									
Right	Right Curb	15	10	Straight	Maximum	1.0	4.0	2.8	1.2
					Minimum	0.2	2.5	7.0	1.0
					Average	0.8	3.1	2.5	1.1
				Right Turn	Maximum		4.0		
					Minimum		2.5		
					Average		3.2		

Table 10. WOODLAWN BUS LINE INITIAL ROAD ODOR STUDIES WITH SMALL PANEL

(Vehicle and Car Moving)



Vehicle:	Bus 695 with A/C On
Sample Location:	4 Man Panel in Car Behind Bus. All Windows and Vents Open
Weather:	88° F, 59% RH, Slight 2-4 MPH breeze out of SSE
Route:	Woodlawn Bus Line - Typical Downtown and Residential Bus Operation

Vehicle Speed MPH	Feet Behind Bus Y	Direction of Bus	Average Odor Intensity			
			Idle	Accel	Const Speed	Deceleration
15	10	Left Turn		2.5		
		Straight	0.8	2.3	1.0	
	15	Straight	0.8			
		Left Turn		2.2		
		Straight	0.5	2.7	1.8	1.5
		Left Turn			2.0	
		Straight	1.0	1.5	1.8	1.0
20	15	Right Turn		2.5		
		Straight	0.9	2.5	1.6	1.8
15	10	Straight		3.5	2.5	
	15	Straight	0.8	2.5		1.0
	20	Straight	0.5	2.6	1.2	1.3
	25	Straight	1.0	2.5		1.0

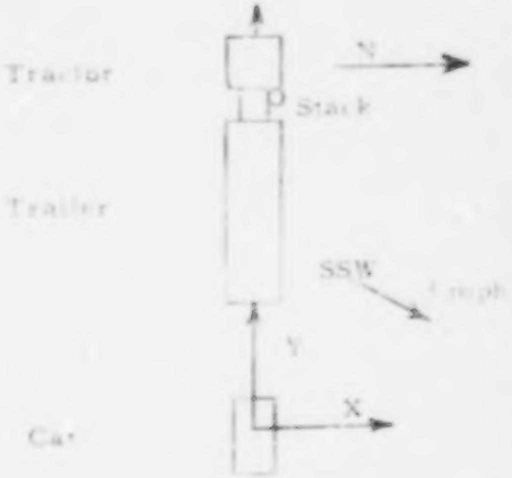
Table 10. WOODLAWN BUS LINE INITIAL ROAD ODOR STUDIES WITH SMALL PANEL
(Vehicle and Car Moving) (Page 2)

Vehicle Speed MPH	Feet Behind Bus Y	Direction of Bus	Average Odor Intensity			
			Idle	Accel	Const Speed	Deceleration
20	15	Straight	0.5	2.8	1.8	1.2
		Right Turn		2.5		
		Left Turn		2.8		0.8
10	10	Straight	2.3		2.0	
		Right Turn		2.2		
	15	Straight			1.5	
	20	Straight			1.8	
	25	Straight			1.1	
25	15	Straight	0.5	3.5	2.0	
		Left Turn		4.0		
	25	Straight			1.5	2.3

Table II. INITIAL HIGHWAY ODOR AND SMOKE SMALL PANEL RESULTS

(Vehicle and Car Moving)

Vehicle	Tractor-Trailer Truck
Sample Location	4-Man Panel in Car Behind Truck. All Windows/Vents Open
Weather	84°F, 40% RH, Slight Breeze at 3 MPH SSW. Blue Sky-Clear
Route	U.S. Highway 90 W from San Antonio to Hondo and Return (Approx. 100 miles)



Vehicle Direction	Vehicle Speed MPH	Type of Road	Sample Obtained at (Feet from truck) X	Sample Obtained at (Feet from truck) Y	Average Odor Intensity	Average Smoke Intensity
W	40-60 (1)	Level	0 (3)	60	0.6	2.0
	60	Level		60	0	1.7
	60	Level		80	0	1.4
	60-35 (2)	Level		60	0	3
	35-60	Downhill	18	60	0.8	2.2
	70	Level		60	0	1.4
	60	Uphill		60	0.4	2.5
	60	Downhill		60	0	2.0
	60	Uphill		60	0	2.4
	60	Level		60	0.8	2.5
	60-70	Downhill	18	100	0	1.2
	70	Level		80	0	1.6
	65	Uphill		40	0.4	2.4
	50	Uphill		40	0	2.[illegible]
	50-60	Downhill		6[illegible]	0.6	2.3
	60	Uphill	18	40	0.4	1.8
	60	Slight Uphill		40	0	1.7
	60	Level		60	0	2.0
	60	Level		80	0	2.0
	60	Level		100	0	1.7

(1) Lower - Higher speeds implies acceleration
(2) Higher - Lower speeds implies deceleration
(3) When directly behind trailer, not possible to see the tip of exhaust stack because of large box profile of trailer.

Table II. INITIAL HIGHWAY ODOR AND SMOKE SMALL PANEL RESULTS (Page 2

(Vehicle and Car Moving)

Vehicle Direction	Vehicle Speed MPH	Type of Road	Sample Obtained at (Feet from truck) X	Y	Average Odor Intensity	Average Smoke Intensity
W	60	Level	15	120	0	1.3
	60	Level		40	0	1.9
	60	Level		60	0	1.6
	60-45	Downhill	15	60	0.6	1.9
	45	Uphill		100	0	1.9
	45	Uphill		60	0	2.4
	30	Uphill		40	0	2.3
	30	Uphill		40	0	2.3
	50	Level		60	0	2.2
	60	Uphill		60	0	2.3
	50	Uphill		60	0	2.2
	50	Uphill		60	0.5	1.7
	50	Level	15	80	0	1.7
	60	Downhill		80	0	1.7
	60	Uphill		80	0	2.2
	70	Downhill		80	0.5	2.0
	70	Downhill		80	0	1.4
	65	Uphill		60	0	1.6
	60	Uphill		80	0	2.4
	60	Uphill	15	40	0	1.9
	40-60	Level		40	0	2.2
	60	Level		40	0	2.3
	60	Uphill		40	0.5	2.2
	60	Level		60	0	2.3
	60	Level		80	0	1.4
	50-70	Downhill		80	0	1.8
	75	Level	15	80	0	2.1
	75	Level		60	0.4	2.1
	75	Level		40	0	2.0
	70	Level		60	0	2.0
	70	Level		40	0	1.6
	70-60	Uphill		60	0	1.4
	60	Downhill		60	0	0.7
	60	Level		80	0	0.4
	60	Level		100	0	0.5

Return to San Antonio

Table II. INITIAL HIGHWAY ODOR AND SMOKE SMALL PANEL RESULTS (Page 3)
(Vehicle and Car moving)

Vehicle Direction	Vehicle Speed MPH	Type of Road	Sample Obtained at (Feet from truck) X	Y	Average Odor Intensity	Average Smoke Intensity
E	0-60	Downhill	15	60	0	2.0
	65	Level		80	0	2.2
	65	Slight Uphill		80	0	2.1
	65	Uphill		40	0	1.8
	65	Downhill		60	0	1.4
	65	Downhill		80	0	1.1
	65	Downhill	0	80	0	1.4
	65	Level		40	0	1.3
	65	Level		20	0	N/D
	60	Level		40	0	1.4
	60	Slight Uphill		60	0	1.7
	50	Uphill		60	0	2.0
	40	Uphill		40	0	2.4
	45	Uphill		40	0.8	1.8
	55	Uphill		40	0.4	2.6
	60	Level		40	0	1.5
	60	Level	0	60	0	1.3
	65	Uphill		60	0	2.1
	60	Level		60	0	2.0
	65	Downhill		60	1.0	1.4
	60	Uphill		80	0	1.5
	60	Uphill		40	0	1.2
	65	Downhill		80	0	0.7
	60	Level		60	0	1.6
	60	Uphill		40	0.4	2.2
	60	Downhill		40	0	1.5
	55	Uphill		60	0	2.2
	55	Level		40	0	1.9
	60-75	Downhill	0	60	0	1.7
	70	Uphill		60	0	0.9
	70-40	Downhill		60	1.0	0
	40-30	Downhill		40	0.5	0.3
	30	Level		40	0	0.2
	30-40	Level		40	0.5	1.0

Table 11. INITIAL HIGHWAY ODOR AND SMOKE SMALL PANEL RESULTS (Page 4)
(Vehicle and Car Moving)

Vehicle Direction	Vehicle Speed MPH	Type of Road	Sample Obtained at (Feet from truck) X	Y	Average Odor Intensity	Average Smoke Intensity
E	50	Uphill	0	40	0	1.9
	50	Level		20	0	2.0
	55	Level		40	0	1.9
	60	Level		60	0	1.7
	65	Level		40	0	1.7
	65	Level		60	0	1.6
	65	Level		80	0	1.9
	65	Level		100	0	1.9
	70	Level		100	0	1.4
	70	Level		80	0	1.0
	70	Level		60	0	0.9
	65	Level		60	0	0.9
	60	Uphill	0	60	0.6	2.1
	60-70	Downhill		60	0	2.0
	70	Level		60	0	1.7
	70	Level		40	0.7	1.5
	65	Uphill		40	0	1.2
	60-75	Downhill		60	0	1.6
	60	Uphill		60	0	1.9
	70	Downhill		60	0	0.9
	70	Level		80	0	0.6
	65	Level		40	0	0.7
	60	Uphill		40	0	1.8
	50	Uphill		40	0	1.4
	45	Uphill		40	0	1.7
	50	Level		40	0	1.4
	50-65	Downhill	0	60	0	0.7
	60	Uphill		60	0	0.3
	60	Level		60	0	0.5
	60-65	Downhill		60	0	0.5
	60	Level		40	0	1.0
	60	Uphill		40	0	1.1
	55	Uphill		40	0	1.2
	55-45	Uphill		40	0	1.7

Table 12. SUMMARY OF TABLE 11 INITIAL HIGHWAY ROAD DATA (SMOKE)

Basis: All conditions which resulted in an average smoke rating of 2.0 or greater.

Vehicle Direction	Vehicle Speed MPH	Type of Road	Sample obtained at (Feet from trailer) X	Y	Average Smoke Intensity
W	40-60 (1)	Level	0 (2)	60	2.0
	35-60	Downhill	15	60	2.2
	60	Uphill	15	60	2.5
	60	Downhill	15	60	2.0
	60	Uphill	15	60	2.4
	60	Level	15	60	2.5
	60-70	Downhill	15	100	2.2
	65	Uphill	15	40	2.4
	50	Uphill	15	40	2.1
	50-60	Downhill	15	60	2.3
	60	Level	15	60	2.0
	60	Level	15	80	2.0
	45	Uphill	15	60	2.4
	30	Uphill	15	40	2.3
	30	Uphill	15	40	2.3
	50	Level	15	60	2.2
	60	Uphill	15	60	2.3
	50	Uphill	15	60	2.2
	60	Uphill	15	80	2.2
	70	Downhill	15	80	2.0
	60	Uphill	15	80	2.4
	40-60	Level	15	40	2.2
	60	Level	15	40	2.3
	60	Uphill	15	40	2.2
	60	Level	15	60	2.3
	75	Level	15	80	2.1
	75	Level	15	60	2.1
	75	Level	15	40	2.0
	70	Level	15	60	2.0

(1) Lower - higher speeds implies vehicle acceleration

(2) When directly behind truck (x = 0), not possible to see the tip of the exhaust stack because of large box profile of trailer

Table 12. SUMMARY OF TABLE 11 INITIAL HIGHWAY ROAD DATA (Page 2) (SMOKE)

Vehicle Direction	Vehicle Speed MPH	Type of Road	Sample obtained at (Feet from trailer) X	Y	Average Smoke Intensity
E	0-60	Downhill	15	60	2.0
	65	Level	15	80	2.2
	65	Uphill	15	80	2.1
	50	Uphill	0	60	2.0
	40	Uphill	0	40	2.4
	55	Uphill	0	40	2.6
	65	Uphill	0	60	2.1
	60	Level	0	60	2.0
	60	Uphill	0	40	2.2
	55	Uphill	0	60	2.2
	50	Level	0	20	2.0
	60	Uphill	0	60	2.1
	60-70	Downhill	0	60	2.0

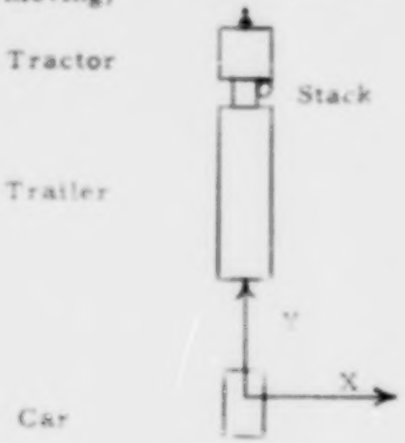
Table 13. ACCELERATION - CONSTANT SPEED, ODOR AND SMOKE SMALL PANEL RESULTS
(Vehicle and Car - Panel Moving)

ehicle: Tractor-Trailer Truck

ample Location: 4-Man Panel in Car
Behind Truck, All
Windows/Vents Open

eather: 70° F, 68% RH,
Blue sky, Calm, No wind

oute: North-South on level Loop 410
and Loop 410 Access Roads



ehicle irection	Vehicle Speed MPH	Type of Road	Vehicle Drive Gear	Sample obtained at (Feet from truck)		Average Odor Intensity	Average Smoke Intensity
				X	Y		
N	0	Level	Neutral	15	20	0	0
	0-20		Acc.		20	0	1.1
	20		4		20	0	0.7
				15	-40	0	0.7
					-20	0	0.5
					0	0	0.6
					40	0	0.7
					60	0	0.7
					80	0	0.4
N	20	Level	4	0	80	0	1.0
					60	0	1.0
					40	0	0.3
					20	0	0
N	20	Level	4	-15	-40	0	N/D
					-20	0	N/D
					0	0	N/D
					20	0	N/D
					40	0	0
					60	0	0.2
					80	0	0.6
	20-40	Level	Acc.		40	0	0.9
	40	Level	7		60	0	0.6
	40	Uphill	7		80	0	2.2
S	40	Level	7	0	40	0.7	0.5
					60	0.3	0.5
					80	0	0.4
					100	0	0.5
					120	0	0.6

able 13. ACCELERATION - CONSTANT SPEED, ODOR AND SMOKE SMALL PANEL RESULTS

(Vehicle and Car - Panel Moving)

(Page 2

ehicle Direction	Vehicle Speed MPH	Type of Road	Vehicle Drive Gear	Sample obtained at (Feet from truck) X	Y	Average Odor Intensity	Average Smoke Intensity
S	40	Level	7	-15	-40	0	N/D
					-20	0	N/D
					0	0	0
					20	0	0
					40	0	0.4
					60	0.2	0.5
					80	0	0.7
					100	0	0.8
N	40	Level	7	15	-40	0	0.4
					-20	0	0.4
					0	0	0.8
					20	0	1.0
					40	0	0.8
					60	0	0.8
					80	0	0.8
	40-60	Level	Acc.	0	40	0.6	2.1
	60		10		40	0.4	1.0
					60	0	1.1
					80	0	0.9
		Uphill			80	0	1.7
		Level			100	0	0.7
					120	0	0.8
					140	0	0.9
					160	0	0.7
		Uphill			160	0	2.2
	60-0	Level	Dec.		100	0	0.2
S	60	Level	10	-15	-40	0	N/D
					-20	0	N/D
					0	0	N/D
					20	0	N/D
					40	0.5	1.0
					60	0.3	1.0
N	0	Level	Neutral	0	40	0	0
	0-40	Level	Acc.		40	0.6	1.7
	40	Downhill	7		40	0.4	0.2
	40	Upnill	7		40	0	1.7

Table 14. INITIAL ROAD, ODOR AND SMOKE STUDIES WITH SMALL PANEL

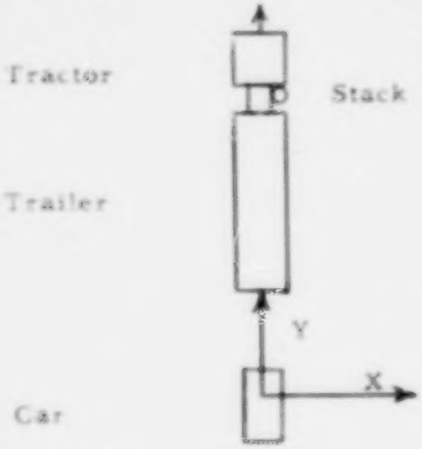
(Vehicle and Car - Panel Moving)

Vehicle: Tractor-Trailer Truck

Sample Location: 4-Man Panel in Car Behind Truck, All Windows/Vents Open

Weather: 72° F, 44% RH, Clear Blue Sky, Calm, No Wind

Route: North-South on Level Loop 410 and Loop 410 Access Roads



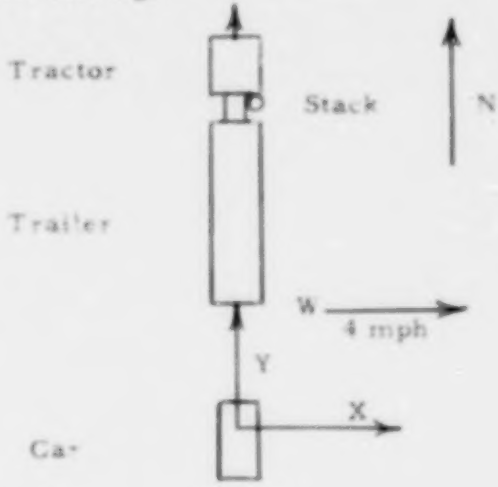
Vehicle Direction	Vehicle Speed MPH	Type of Road	Vehicle Drive Gear	Sample Obtained at (Feet from truck) X	Y	Average Odor Intensity	Average Smoke Intensity
N	0	Level	Neutral	15	20	0	0
	0-10(1)		2			0	0.8
	10		2			0	0.6
	10-15		3			0	0.8
	15		3			0	0.7
	15-20		4			0	1.0
	20		4			0	0.7
	20-25		5			0	1.3
	25		5			0	1.0
	25	Uphill	5			0	2.2
	25-30	Level	6			0	1.0
	30		6			0	1.0
	30-35		7			0	1.6
	35		7			0	1.3
	35-40		7			0	1.6
	40		7			0	1.5
	40-50		8			0	1.9
	50		8			0	2.0
	50-60		9			0	1.9
	60		9			0	2.0

(1) Higher Speeds implies acceleration

Table 15. INITIAL ROAD ODOR AND SMOKE STUDIES WITH SMALL PANEL

(Vehicle and Car - Panel Moving)

Vehicle:	Tractor-Trailer Truck
Sample Location:	4-Man Panel in Car Behind Truck, All Windows/Vents Open
Weather:	84°F, 70% RH, Slight 4 MPH Breeze out of West, Cloudy overcast
Route:	North-South on level Loop 410 and Loop 410 Access Roads



Vehicle Direction	Vehicle Speed MPH	Max. Speed in Gear No.	Sample obtained at (Feet from Truck) X	Sample obtained at (Feet from Truck) Y	Average Odor Intensity	Average Smoke Intensity
N	0	Neutral	15	20	0	0
	0-10 (1)	2			0	0.7
	10-15	3			1.0	1.9
	15	3			0	0.5
	15-20	4			0.7	2.2
	20	4			0	0.5
S	0	Neutral	15	20	0	0
	0-15	3			0	1.0
	15	3			0	0.6
	15-20	4			0	1.0
	20	4			0	0.6
	20-25	5			0	1.7
	25	5			0	0.6
	25-30	6			0	2.0
	30	6			0	0.5
	30-40	7			0.4	1.7
	40	7			0	0.6
	40-50	8			0.4	1.9
	50	8			0.3	0.8
	50-55	9			0.3	2.1
	55	9			0.3	1.6

(1) Lower-higher speeds implies acceleration.

Table 15. INITIAL ROAD ODOR AND SMOKE STUDIES WITH SMALL PANEL (Page 2

(Vehicle and Car - Panel Moving)

Vehicle Direction	Vehicle Speed MPH	Max. Speed in Gear No.	Sample obtained at (Feet from Truck) X	Y	Average Odor Intensity	Average Smoke Intensity
N	0	Neutral	15	0	0	0
	0-5	1			0	1.1
	5	1			0.2	0.3
	5-10	2			0.2	1.2
	10	2			0.2	0.5
	10-15	3			0.9	1.6
	15	3			0.9	0.6
	15-20	4			0.5	1.9
	20	4			0.2	0.7
	20-25	5			1.3	2.1
	25	5			0.4	0.9
	25-30	6			1.4	2.4
	30	6			0.5	0.9
	30-40	7			0.7	2.2
	40	7			0	0.7
	40-50	8			0.5	2.4
	50	8			0.4	1.0
	50-60	9			0	2.1
	60	9			0.2	1.8
S	0	Neutral	15	0	0	0
	0-5	1			0	1.8
	5	1			0	0.5
	5-10	2			0	1.3
	10	2			0	0.5
	10-15	3			0	1.6
	15	3			0	0.5
	15-20	4			0	0.9
	20	4			0	0.5
	20-25	5			0	1.0
	25	5			0	0.5
	25-30	6			0	1.4
	30	6			0	0.8
	30-40	7			0	1.3
	40	7			0	0.8
	40-50	8			0	1.7
	50	8	15	20	0	1.3
	50-60	9			0	1.8
	60	9			0	1.1
	60-65	10			0	1.9
	65	10			0	1.3

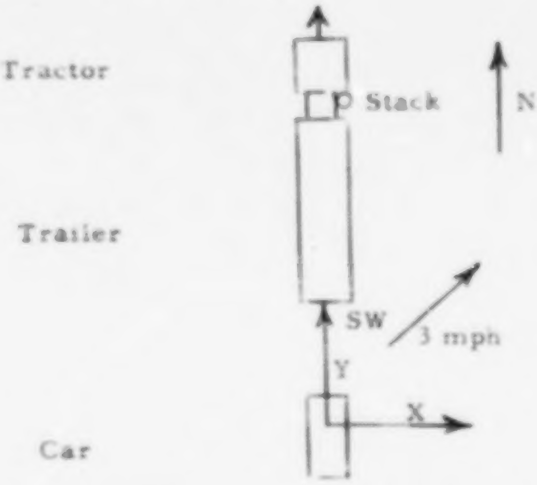
Table 15, INITIAL ROAD ODOR AND SMOKE STUDIES WITH SMALL PANEL (Page 3
(Vehicle and Car - Panel Moving)

Vehicle Direction	Vehicle Speed MPH	Max. Speed in Gear No.	Sample obtained at (Feet from Truck) X	Sample obtained at (Feet from Truck) Y	Average Odor Intensity	Average Smoke Intensity
N	0	Neutral	15	20	0	0
	0-5	1			0	0.7
	5	1			0	0.5
	5-10	2	15	20	0.6	0.9
	10	2			0	0.5
	10-15	3			0	0.5
	15	3			0	0.5
	15-20	4			0	1.1
	20	4			0	0.7
	20-25	5			0	1.5
	25	5			0	0.8
	25-30	6			0.2	1.5
	30	6			0	1.0
	30-40	7			0	1.5
	40	7			0	1.0
	40-50	8			0	1.2
	50	8			0	1.2
	50-55	9			0	1.8
	55	9			0	1.4
	55-60	10			0	1.9
	60	10			0.2	1.7
	60	10	15	60	1.2	1.9
	60	10	15	40	0.9	2.0
	60	10	15	20	1.0	1.8

Table 16. CONSTANT SPEED ODOR STUDIES WITH SMALL PANEL

(Vehicle and Car - Panel Moving)

Vehicle:	Tractor-Trailer Truck
Sample Location:	4-Man Panel in Car Behind Truck, All Windows/Vents Open
Weather:	80°F, 90% RH Slight 3 mph. breeze out of SW, Cloudy Too overcast to rate smoke
Route:	North-South on Level Loop 410 and Loop 410 Access Road



Vehicle Direction	Vehicle Speed MPH	Vehicle Drive Gear	Sample obtained at (Feet from Truck) X	Sample obtained at (Feet from Truck) Y	Average Odor Intensity
S	0 (Idle)	Neutral	15	-60	0
				-40	0
				-20	0
				0	0
				20	0
				40	0
S	0 (Idle)	Neutral	0	0	0
				20	0
				40	0
S	0 (Idle)	Neutral	-15	-60	0
				-40	0
				-20	0
				0	0
				20	0
				40	0
S	10	2	-15	-60	0
				-40	0
				-20	0
				0	0
				20	0
				40	0.2
				60	0
S	10	2	0	20	0
				40	0
				60	0

Table 16. CONSTANT SPEED ODOR STUDIES WITH SMALL PANEL (Page 2
(Vehicle and Car - Panel Moving)

Vehicle Direction	Vehicle Speed MPH	Vehicle Drive Gear	Sample obtained at (Feet from Truck) X	Y	Average Odor Intensity
S	10	2	15	-60	0
				-40	0
				-20	0
				0	0
				20	0
				40	0
				60	0
S	20	4	15	-60	0
				-40	0
				-20	0.3
				0	0.2
				20	0.3
				40	0.3
				60	0
	20	4	0	60	0
				40	0
				20	0
				0	0
	20	4	15	-60	0
				-40	0
				-20	0
				0	0
				20	0
				40	0
				60	0
N	20	4	15	-60	0
				-40	0
				-20	0.7
				0	0.5
				20	0.5
				40	0.5
				60	0
N	20	4	0	60	0
				40	0
				20	0

Table 16. CONSTANT SPEED ODOR STUDIES WITH SMALL PANEL (Page
(Vehicle and Car - Panel Moving)

Vehicle Direction	Vehicle Speed MPH	Vehicle Drive Gear	Sample obtained at (Feet from Truck) X	Y	Average Odor Intensity
N	20	4	-15	-60	0
				-40	0
				-20	0
				0	0
				20	0
				40	0
				60	0
N	30	6	0	20	0.5
				40	0.2
				60	0
N	30	6	15	-60	0
				-40	0
				-20	0.5
				0	0.5
				20	0.3
				40	0
				60	0
S	30	6	-15	-60	0
				-40	0
				-20	0
				0	0
				20	0.4
				40	0.2
				60	0.2
S	40	7	0	20	0
				40	0.2
				60	0
				80	0
				100	0
				120	0
S	40	7	-15	-40	0.4
				-20	0.4
				0	0.5
				20	0.3
				40	0
				60	0
				80	0
				100	0
				120	0

Table 16. CONSTANT SPEED ODOR STUDIES WITH SMALL PANEL (Page 4
(Vehicle and Car - Panel Moving)

Vehicle Direction	Vehicle Speed MPH	Vehicle Drive Gear	Sample obtained at (Feet from Truck) X	Sample obtained at (Feet from Truck) Y	Average Odor Intensity
N	40	7	15	-40	0
				-20	0.2
				0	0.2
				20	0.3
				40	0.2
				60	0.2
				80	0
N	0-50	Acc.	0	20	1.1
	50	9		20	0.2
				40	0.5
				60	0.2
				80	0
				100	0
				120	0
S	0-60	Acc.	0	20	0
	60	10		20	0
				40	0.3
				60	0.2
				80	0
				100	0
				120	0
				140	0
S	60	10	-15	60	0.2
				40	0.2
				20	0
	60-0	Dec.		20	0.4
N	0-60	Acc.	0	40	1.7
	60	10		40	0.6
				20	0
				40	0.4
				60	0.8
				80	0.6
				100	0
				120	0
				140	0

Table 16. CONSTANT SPEED ODOR STUDIES WITH SMALL PANEL (Page 5)
(Vehicle and Car - Panel Moving)

Vehicle Direction	Vehicle Speed MPH	Vehicle Drive Gear	Sample obtained at (Feet from Truck) X	Y	Average Odor Intensity
S	0-50	Acc.	0	40	0.4
	50	9		40	0.3
				60	0.5
				80	0
				100	0
				120	0
		9	-15	60	0
				40	0.3
	50-0	Dec.		40	0.5
N	0-60	10	0	60	1.0
	60			60	0.4
				80	0.4
				100	0.2
				120	0
				140	0
				40	0.4
				60	0.2
	60-0	Dec.		60	1.0
E	0-40	Acc.	0	40	0.6
	40	7		40	0.4
				20	0.2
				60	0.2
				80	0
				100	0

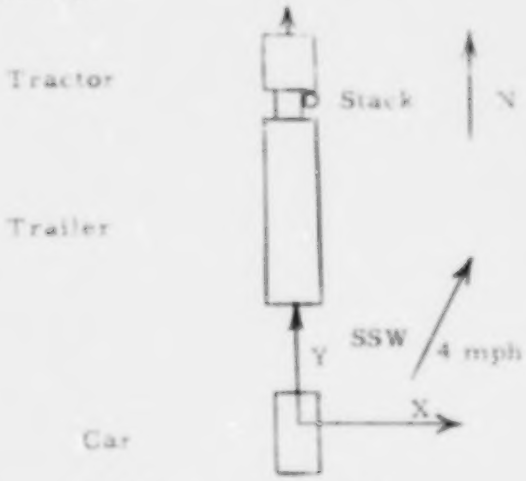
Table 17. EXPRESSWAY ODOR AND SMOKE SMALL PANEL RESULTS
(Vehicle and Car Moving)

Vehicle: Tractor-Trailer Truck

Sample Location: 4-Man Panel in Car
Behind Truck, All
Windows/Vents Open

Weather: 88°F, 41% RH
Wind Steady at
4 mph from SSW

Route: Northwest-Southeast over crowded
IH 35 Expressway
(Numerous overpasses and walls)



Vehicle Direction	Vehicle Speed MPH	Type of Road	Sample Obtained at (Feet from Truck) X	Y	Average Odor Intensity	Average Smoke Intensity
NW	60	Level	0	40	0	2.0
	65	Level		60	0	1.5
	65	Uphill		60	0	2.2
	65	Level		80	0	1.9
	65	Uphill		80	0.4	2.7
	70	Level		60	0	2.4
	70	Uphill		60	0	2.0
	60	Uphill		40	0	1.9
	65	Level		60	0	1.7
NW	65	Uphill	15	40	0.2	2.5
	65	Level		60	0.4	0.9
	60	Uphill		40	0	2.5
NW	60	Level	0	40	0.8	1.2
	55	Uphill		60	0.5	1.1
	55	Level		60	1.1	0.7
	50	Uphill		40	0.5	2.3
	60	Level		40	1.8	1.6
	40	Uphill		20	0	2.0
	55	Downhill		40	0.7	1.7
	45	Uphill		40	0.9	2.3

Table 17. EXPRESSWAY ODOR AND SMOKE SMALL PANEL RESULTS (Page 2)
(Vehicle and Car Moving)

Vehicle Direction	Vehicle Speed MPH	Type of Road	Sample Obtained at (Feet from Truck)		Average Odor Intensity	Average Smoke Intensity
			X	Y		
NW	50	Level	0	40	0.7	1.2
	45	Level		40	0.5	0.8
	55	Level		40	0.2	1.9
	40	Uphill		40	0	1.5
	50	Uphill		40	0.3	1.6
	50-0	Uphill		40	0.6	0
SW	0-40	Downhill	0	40	0.5	2.0
	40	Uphill		40	0.7	1.6
	40	Downhill		40	0	1.3
	40	Level		40	0.6	0.7
	40	Uphill		40	0	1.5
	40	Level		40	0.2	0.7
	40-0	Level		40	0.4	0
NW	0	Level	0	40	0	0
	0-40	Level		40	0.3	2.2
	0-40	Uphill		40	0.2	2.2
	40	Downhill		40	0.8	0.6
	40	Level		40	0.7	0.6
	40	Uphill		40	0.5	1.5
	40	Uphill		40	0.5	1.8
	40	Downhill		40	0.4	0.9
	40	Uphill		40	0.6	1.6
	40-0	Uphill		40	0.9	0
SW	0	Level	0	40	0.3	1.9
	0-50	Level		40	0	2.2
	40	Uphill		40	0.9	1.2
	50	Downhill		40	0.5	0.9
	50	Downhill		40	0.2	0.8
	50	Level		40	0	0.5
	50	Level		40	0	0.3
	45	Level		40	0.5	0.5
	45-0	Level		40	0.8	0

Table 18. DOWNTOWN ROAD ODOR AND SMOKE SMALL PANEL RESULTS

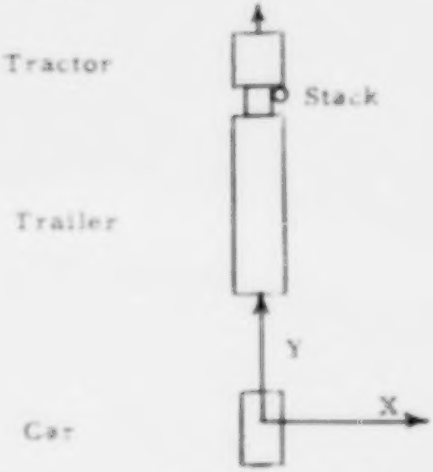
(Vehicle and Car Moving)

Vehicle: Tractor-Trailer Truck

Sample Location: 4-Man Panel in Car Behind Truck, All Windows/Vents Open

Weather: 82°F, 58% RH
Calm, No Wind
Clear Blue Sky

Route: Downtown Driving Pattern as Shown in Figure 20 of Appendix B



Vehicle Speed MPH	Sample Obtained at (Feet from Truck) X	Sample Obtained at (Feet from Truck) Y		Average Panel Intensity Rating Odor	Average Panel Intensity Rating Smoke
0 (Idle)	0	20	Maximum	0	0
			Minimum	0	0
			Average	0	0
0-20 (Acceleration)	0	20	Maximum	0.4	1.2
			Minimum	0	0.7
			Average	0.2	1.1
20 (Constant Speed)	0	20	Maximum	0.2	0.6
			Minimum	0	0.1
			Average	0.1	0.3
20-0 (Deceleration)	0	20	Maximum	0.7	0
			Minimum	0.2	0
			Average	0.4	0
0 (Idle)	0	40	Maximum	0	0
			Minimum	0	0
			Average	0	0
0-20 (Acceleration)	0	40	Maximum	0	1.8
			Minimum	0	0.4
			Average	0	0.9
20 (Constant Speed)	0	40	Maximum	0	0.8
			Minimum	0	0
			Average	0	0.5

Table 18. DOWNTOWN ROAD ODOR AND SMOKE SMALL PANEL RESULTS (Page

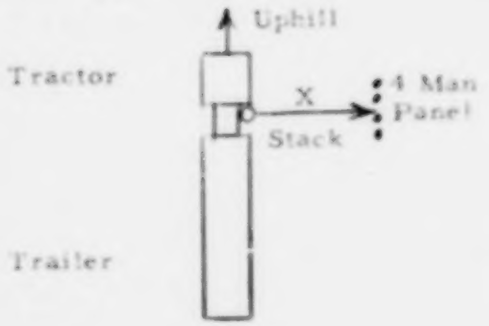
(Vehicle and Car Moving)

Vehicle Speed MPH	Sample Obtained at (Feet from Truck)			Average Panel Intensity Rating	
	X	Y		Odor	Smoke
20-0 (Deceleration)	0	40	Maximum	0	0.4
			Minimum	0	0
			Average	0	0.1
0 (Idle)	15	0	Maximum	0	0
			Minimum	0	0
			Average	0	0
0-20 (Acceleration)	15	0	Maximum	1.0	2.0
			Minimum	0	1.3
			Average	0.2	1.6
20 (Constant Speed)	15	0	Maximum	0	1.2
			Minimum	0	0.3
			Average	0	0.6
20-0 (Deceleration)	15	0	Maximum	1.0	0
			Minimum	0	0
			Average	0.4	0

Table 19. UPHILL ROADSIDE ODOR AND SMOKE SMALL PANEL RESULTS

(Vehicle Moving, Panel Stationary)

Vehicle:	Tractor-Trailer Truck
Sample Location:	4-Man Panel Positional on Roadside Shoulder
Weather:	76°F, 85% RH Calm, No Wind
Route:	Commerce and Culebra Road Hills



Hill	Vehicle Speed MPH	Engine (1) Power Conditions	Sample Obtained at (Feet from Truck) X	Average Odor Intensity	Average Smoke Intensity
Commerce	30	Lugging (2)	20	0	2.2
	20	Lugging	20	0	2.4
	40	Lugging	10	0	2.6
	45	Lugging	10	0	2.8
	30	Lugging	20	0	2.6
	30	Lugging	20	0.1	2.3
	40	Normal (3)	10	0.4	1.2
	50	Lugging	10	0.7	2.4
	60	Lugging	10	0.2	2.3
Culebra	60	Lugging	10	0.6	2.7
	50	Lugging	10	0.1	2.7
	40	Normal	20	0	1.2
	60	Normal	20	0.1	1.2
	50	Normal	10	0.2	1.1

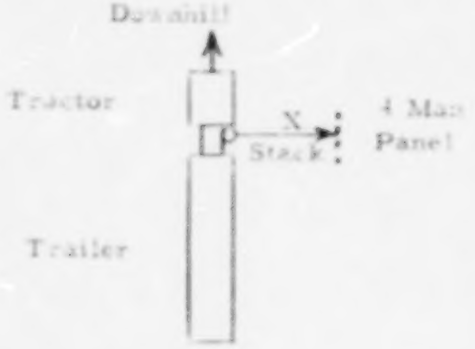
(1) Engine operated at open rack (except during downshift).

(2) Lugging means operating at below the recommended 1700 rpm minimum engine speed (about 1400 rpm).

(3) Normal means downshifting when engine rpm decreases to 1700 rpm.

Table 20. DOWNHILL ROADSIDE ODOR AND SMOKE SMALL PANEL RESULTS
(Vehicle Moving, Panel Stationary)

Vehicle:	Tractor-Trailer Truck
Sample Location:	4-Man Panel Positional on roadside shoulder
Weather:	76°F, 85% RH, Calm, No wind
Route:	Commerce and Culebra Road Hills



Hill	Vehicle (1) Speed MPH	Sample Obtained at (Feet from Truck) X	Average Odor Intensity	Average Smoke Intensity
Commerce	30	10	1.5	0.2
	35	10	1.0	0.1
	30	20	1.3	0.1
	30	-20	0.7	0
	35	20	0.5	0.1
	50	10	1.0	0.1
Culebra	50	10	1.1	0.1
	50	20	0.9	0
	40	10	1.7	0
	60	10	1.8	0.5

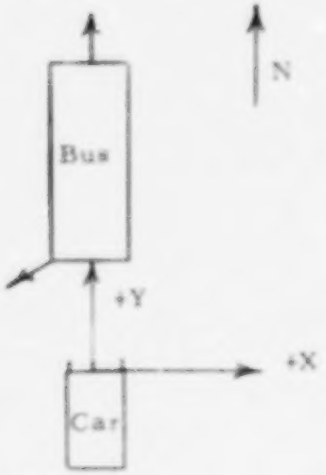
(1) Engine operated at Closed Rack during all downhill decelerations.

APPENDIX B

ATMOSPHERIC EXHAUST DILUTION RESULTS

Table 1. STATIC EXHAUST DILUTION RESULTS
(Vehicle and Car Stationary)

Vehicle:	Bus 695, A/C on
Sample Location:	6 Probe Manifold, front of car
Weather:	80° F, 70% RH, Calm, No Wind
Route:	Bus and Car Located in Parking Lot, Dilution Measured at Various Engine Speeds

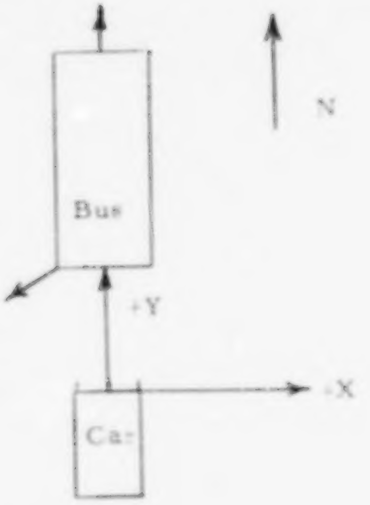


Engine Speed, RPM	Sample Obtained at (Feet from Bus) X	Sample Obtained at (Feet from Bus) Y	Dilution Ratio	Sample Obtained at (Feet from Bus) X	Sample Obtained at (Feet from Bus) Y	Dilution Ratio
420	0	10	197	0	30	328
735			265			340
1050			185			558
1575			215			199
2100			166			228
420	0	20	328	0	40	411
735			262			338
1050			270			330
1575			181			236
2100			140			226
420	0	50	273	-10	20	364
735			329			85
1050			220			105
1575			195			239
2100			152			202
420	-10	0	193	-10	30	547
735			81			1177
1050			84			334
1575			51			1166
2100			70			304

Table 1. STATIC EXHAUST DILUTION RESULTS Page 2.
(Vehicle and Car Stationary)

Engine Speed, RPM	Sample Obtained at (Feet from Bus) X	Sample Obtained at (Feet from Bus) Y	Dilution Ratio	Sample Obtained at (Feet from Bus) X	Sample Obtained at (Feet from Bus) Y	Dilution Ratio
420	-10	5	56	-10	40	289
735			57			273
1050			38			220
1575			41			184
2100			35			152
420	-10	10	86	-10	50	547
735			122			592
1050			99			403
1575			116			333
2100			121			304
420	-20	-10	122	-20	10	805
735			90			35
1050			83			33
1575			45			159
2100			73			44
420	-20	- 5	237	-20	20	657
735			89			442
1050			58			669
1575			102			394
2100			74			130
420	-20	0	656	-20	30	656
735			69			322
1050			38			646
1575			32			333
2100			40			456
420	-20	5	820	-20	40	546
735			99			564
1050			53			326
1575			29			265
2100			34			259
420	-20	50	878			
735			240			
1050			412			
1575			291			

Table 2. STATIC EXHAUST DILUTION RESULTS
(Vehicle and Car Stationary)



Vehicle: Bus 695, A/C on

Sample Location: 6 Probe Manifold, front of car

Weather: 94° F, 56% RH, Wind Variable

Route: Bus and Car Located in Parking Lot. Dilution Measured at Various Engine Speeds

Engine Speed RPM	Wind Condition Speed MPH	Wind Condition Direction (See Sketch)	Sample Obtained at (Feet from Bus) X	Sample Obtained at (Feet from Bus) Y	Dilution Ratio
420	5	↘	-10	20	174
735					171
1050					157
1575					112
2100					127
420	6	↖	-10	10	105
735					79
1050					68
1575					47
2100					66
420	5	↘	0	20	51
735					67
1050					66
1575					117
2100					73
420	5	↘	0	20	317
735					96
1050					95
1575					113
2100					31
420	1	←	0	20	476
735					344
1050					378
1575					204
2100					289

Table 2. STATIC EXHAUST DILUTION RESULTS Page 2.

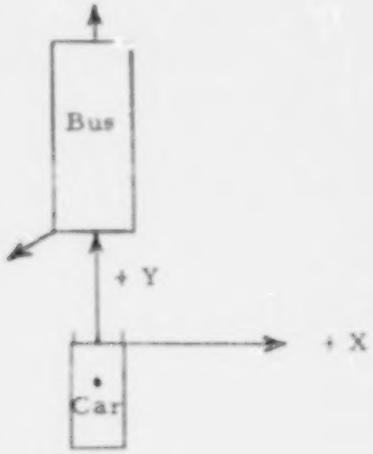
(Vehicle and Car Stationary)

Engine Speed RPM	Wind Condition Speed MPH	Wind Condition Direction (See Sketch)	Sample Obtained at (Feet from Bus) X	Sample Obtained at (Feet from Bus) Y	Dilution Ratio
420	5	↗	0	20	835
735					314
1050					236
1575					107
2100					112
420	6	↓	0	10	53
735					48
1050					87
1575					308
2100					173
420	4	↗	0	30	698
735					118
1050					75
1575					95
2100					190
420	6	↙	0	20	522
735					377
1050					330
1575					223
2100					173
420	5	←	0	10	695
735					598
1050					551
1573					410
2100					100
420	5	↑	-15	10	523
735					629
1050					127
1575					308
2100					238
420	5	↙	-15	5	418
735					37
1050					32
1575					27
2100					28

Table 2. STATIC EXHAUST DILUTION RESULTS Page 3
(Vehicle and Car Stationary)

Engine Speed RPM	Wind Condition Speed MPH	Wind Condition Direction (See Sketch)	Sample Obtained at (Feet from Bus) X	Sample Obtained at (Feet from Bus) Y	Dilution Ratio
420	5	↘	-12	2	37
735					27
1050					23
1575					30
2100					59
420	5	↙	-25	10	523
735					199
1050					75
1575					56
2100					32

Table 3. IDLE-ACCELERATION EXHAUST DILUTION RESULTS
(Vehicle Moving, Static Sample)



Vehicle:	Bus 695, A/C on
Sample Location:	Six Probe Manifold on Front of Car
Weather:	74°F, 88% RH, Calm, No Wind
Route:	Bus Idled for 1 Minute and then accelerated at full rack away from car

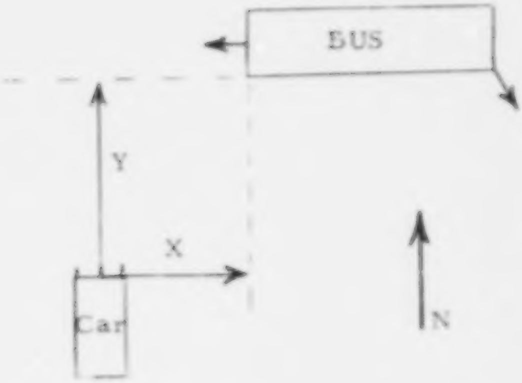
Sample Obtained at (Feet from bus)		Dilution Ratio	
X	Y	Idle	Acc
0	5	2840	4110
-10	-30	2215	73
-10	-25	2885	98
-10	-20	2985	108
-10	-15	1409	111
-10	-10	797	88
-10	- 5	39	164
-10	0	26	101
-10	5	32	86
-10	10	64	75
-10	15	143	185
-10	20	526	949
-10	25	839	3620

Sample Location: Single probe located center of front seat, head high - all windows down and vents open

-15	-25	282	434
-15	-20	308	403
-15	-15	140	185
-15	-10	149	275
-15	- 5	123	408
-15	0	101	587
-15	10	135	725
-15	20	377	889

Table 4. IDLE-ACCELERATION EXHAUST DILUTION RESULTS
(Vehicle Moving, Static Sample)

Vehicle:	Bus 695, A/C On
Sample Location:	Six Probe Manifold On Front of Car
Weather:	70°F, 82% RH, Calm, No Wind
Route:	Bus idled for 1 minute and then accelerated at full rack



Sample Obtained At (Feet from Bus)		Dilution Ratio	
X	Y	Idle	Acceleration
0	20	333	182
-18	20	266	197
-36	20	172	381
-56	20	620	553
0	10	925	268
-18	10	274	166
-36	10	276	88
-46	10	67	39
-51	10	92	59
0	5	742	67
-18	5	970	102
-36	5	315	57
-46	5	35	45
-56	5	22	58
-66	5	135	992

Table 5. IDLE-ACCELERATION EXHAUST DILUTION RESULTS

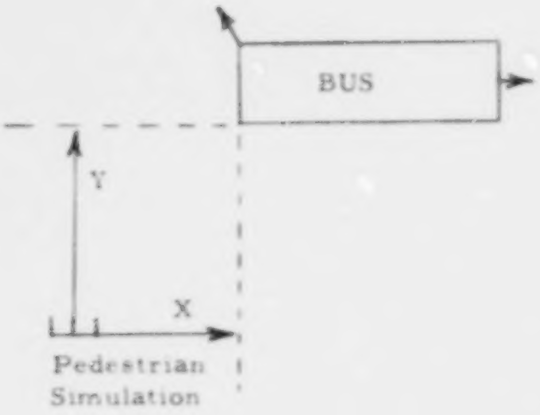
(Vehicle Moving, Static Sample)

Vehicle: Bus 695, A/C On

Sample Location: Pedestrian Simulation, Probe Manifold Located 5 feet above curb, horizontal

Weather: 84°, 72% RH, Calm, 0-1 MPH Wind Variable

Route: Bus idled for 1 min. and then accelerated at full rack



Sample Obtained at (Feet from bus)		Dilution Ratio	
X	Y	Idle	Acceleration
-46	3	835	269
-36	3	298	538
-14	3	568	642
0	3	679	520
+10	3	863	989
New Street Corner			
3	0	393	270
0	15	486	493
0	10	361	495
0	5	348	261
-18	5	323	268
-36	5	336	370

Table 6. IDLE-ACCELERATION EXHAUST DILUTION RESULTS

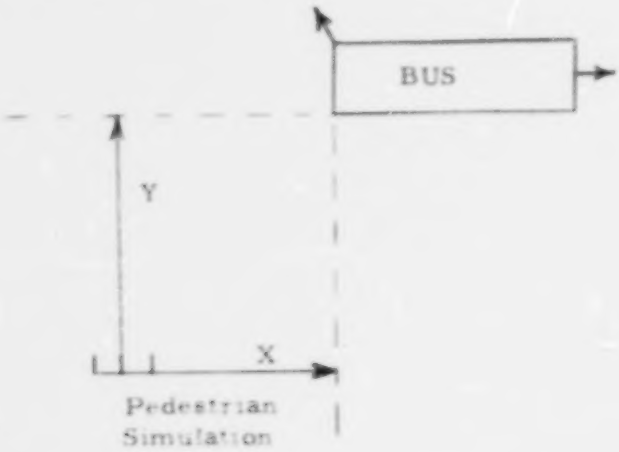
(Vehicle Moving, Static Sample)

Vehicle: Bus 695, A/C On

Sample Location: Six Probe Manifold Located 1 foot above ground, horizontal

Weather: 72° F, 88% RH, Calm, no wind

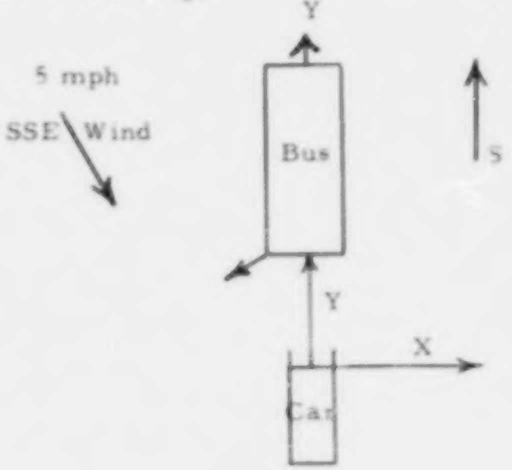
Route: Bus Idled for 1 min., then accelerated at full rack past sampling manifold.



Sample Obtained at (Feet from bus)		Dilution Ratio	
X	Y	Idle	Acceleration
-36	1	538	191
-18	1	500	342
0	1	506	591
5	1	766	611
10	1	900	640
-46	5	900	641
-36	5	630	490
-14	5	635	506
0	5	270	810

Table 7. CONSTANT SPEED EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)



Vehicle:	Bus 695, A/C on
Sample Location:	Six Probe Manifold on Front of Car
Weather:	90°F, 65% RH, Slight Breeze Out of SSE Steady at 5 MPH
Route:	South on Flat Loop 410 Access Test Route

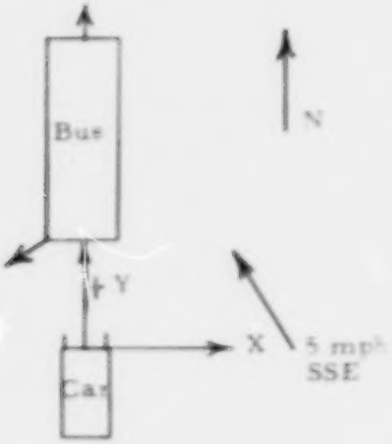
Sample Obtained At (feet from bus)		Vehicle Speed, MPH	Dilution Ratio
X	Y		
0	5	5	128
0	10	5	74
0	20	5	98
0	30	5	187
0	40	5	420
0	50	5	825
0	60	5	4490
0	70	5	
-10	10	5	449
-10	20	5	204
-10	30	5	214
-10	40	5	204
-10	50	5	224
-10	60	5	204
+10	0	5	4490
+10	10	5	4490
+10	20	5	346
+10	30	5	249
+10	40	5	449
+10	50	5	449
+10	60	5	562
+10	70	5	642

Table 7. CONSTANT SPEED EXHAUST DILUTION RESULTS Page 2

(Vehicle and Car Both Moving)

Sample Obtained At (feet from bus)		Vehicle Speed, MPH	Dilution Ratio
X	Y		
0	10	10	
0	20	10	161
0	30	10	526
0	40	10	4350
0	50	10	
0	60	10	
-10	0	10	338
-10	10	10	436
-10	20	10	335
-10	30	10	300
-10	40	10	312
-10	50	10	308
+10	0	10	727
+10	10	10	436
+10	20	10	441
+10	30	10	523
0	10	15	74
0	20	15	104
0	30	15	393
0	40	15	430
0	50	15	
-10	0	25	1550
-10	10	25	516
0	20	35	224
0	30	35	360
0	40	35	400
0	50	35	790
0	10	40	310
0	20	40	190
0	30	40	195
0	40	40	340
0	50	40	372

Table 8. CONSTANT SPEED EXHAUST DILUTION RESULTS
(Vehicle and Car Both Moving)



Vehicle	Bus 695, A/C On
Sample Location:	6 Probe Manifold in front of car
Weather	90° F, 65% RH, Slight breeze out of SSE, Steady at 5 MPH
Route	North on Flat Loop 410 Access Test Route

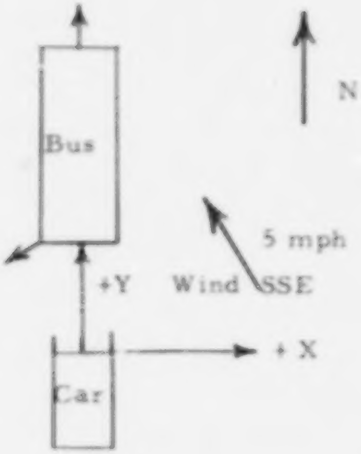
Sample Obtained at (Feet From Bus) X	Y	Vehicle Speed, MPH	Dilution Ratio
0	10	15	160
0	20	15	138
0	30	15	206
0	40	15	215
0	50	15	331
0	60	15	524
-10	0	15	214
-10	10	15	142
-10	20	15	85
-10	30	15	160
-10	40	15	207
-10	50	15	256
0	20	25	173
0	30	25	178
0	40	25	170
0	20	30	359
0	30	30	308
0	40	30	541
0	20	40	276
0	30	40	290
0	40	40	290
0	50	40	473
0	60	40	627

Table 8. CONSTANT SPEED EXHAUST DILUTION RESULTS Page 2.
(Vehicle and Car Both Moving)

Sample Obtained at (Feet from Bus) X	Y	Vehicle Speed, MPH	Dilution Ratio
0	20	45	202
0	30	45	260
0	40	45	332
0	50	45	367
0	60	45	458

Table 9. CONSTANT SPEED EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)



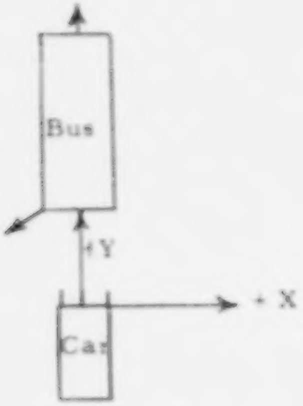
Vehicle:	Bus 695, A/C On
Sample Location:	Six Probe Manifold, Front of Car
Weather:	86°F, 79% RH, Slight Breeze out of SSE Steady at 5 MPH
Route:	North-South on Level Loop 410 Access Roads

Run Direction	Vehicle Speed	Sample Obtained at (Feet from bus) X	Sample Obtained at (Feet from bus) Y	Dilution Ratio
N	5	0	20	335
	10			198
	15			213
	20			312
	30			505
S	25	0	20	560
	30			714
N	5	0	10	2670
			20	1601
			30	2200
			40	4330
N	10	0	[illegible]	487
			20	250
			30	2215
			40	4430
			50	∞
			60	∞
N	15	0	10	465
			20	730
N	30	0	30	523
			40	833

Table 10 IDLE-ACCELERATION-CONSTANT SPEED EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)

Vehicle:	Bus 695, A/C on
Sample Location:	Six Probe Manifold, Front of Car
Weather:	73°F, 91% RH, Calm, No Wind
Route:	North-South on Level Loop 410 Access Roads



Run Direction	Vehicle Speed, MPH	Sample Obtained at (Feet from Bus) X	Sample Obtained at (Feet from Bus) Y	Dilution Ratio Idle	Dilution Ratio Acceleration	Dilution Ratio Const Speed
N	0	0	10	182		
	0 - 40	0	40		159	
	40	0	30			222
			40			250
			50			444
			60			536
			70			940
S		10	20			189
			30			368
			40			415
			50			399
			60			562
			70			664
			80			562
			90			795
			100			875
N	0	0	20	992		
	0 - 45		20		369	
	45		20			457
			30			256
			40			300
			50			385
			60			404
			70			462
			90			605
S	25	0	20			121
			30			194
			40			283
			50			476

Table 10. IDLE-ACCELERATION-CONSTANT SPEED EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)

Run Direction	Vehicle Speed, MPH	Sample Obtained at (Feet from Bus) X	Y	Dilution Ratio Idle	Acceleration	Const Speed
S	0	0	20			110
	0 - 40		20			780
	40		20			750
			30			938
			40			1071
			50			1250
			60			1878
			70			3780
			80			3750
			100			
N	0 - 45	0	30		190	
Slight	45		10			163
cross wind			20			158
in negative "X" direction			30			244
			40			177
			50			239
		-10	30			218
S	0	0	10	37		
Slight	0		20	80		
cross wind	0 - 20		20		134	
in positive	20		30			154
"X" direction			30			287
			40			370
		-10	20			2000
S	0	0	10	110		
	0 - 30		30		304	
	30		10			407
			20			231
			30			925
			40			1361
			50			2267
		-10	30			1350

Table 10. IDLE-ACCELERATION-CONSTANT SPEED EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)

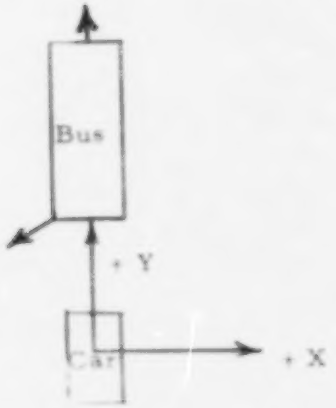
Page 3

Run	Vehicle	Sample Obtained at (Feet from Bus)		Dilution Ratio		
Direction	Speed, MPH	X	Y	Idle	Acceleration	Const Speed
N	0	0	15	108		
	0 - 45		30		362	
	45		20			268
			30			257
		-10	20			299
			30			256
			40			248
N	40	0	10			176
			20			185
			30			196
			40			258

Table 11. IDLE-ACCELERATION-CONSTANT SPEED EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)

Vehicle:	Bus 695, with A/C
Sample Location:	Inside car, center of front seat, head high, single probe
Weather:	83° F, 70% RH, calm, no wind
Route:	North-South on level Loop 410 access roads



Run Direction	Vehicle Speed	Sample Obtained at (Feet from bus) X	Sample Obtained at (Feet from bus) Y	Dilution Ratio Idle	Dilution Ratio Acceleration	Dilution Ratio Const Speed
S	0	0	10	598		
	0		20	795		
	0 - 20		20		109	
	20		30			208
			40			217
			50			300
S	0	0	20	474		
	0 - 35	0	20		278	
	35		10			495
			20			243
			30			429
			40			829
			50			1263
N	0	0	20	908		
	0 - 40		20		294	
	40		10			315
			20			676
			30			736
			40			740
			50			935
			60			1880
S	0	0	10	796		
	0 - 15	0	20		115	
	15	0	10			460
			20			109
			30			269

Table II. IDLE-ACCELERATION-CONSTANT SPEED EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)

Run Direction	Vehicle Speed	Sample Obtained at (Feet from bus) X	Sample Obtained at (Feet from bus) Y	Dilution Ratio Idle	Dilution Ratio Acceleration	Dilution Ratio Const Speed
S	0 - 30		40		476	
	30		10			160
			20			203
			30			436
			40			1045
			50			920
			60			1388
N	0 - 45	0	20		406	
	45		10			277
			20			299
			30			382
			40			482
			50			798
			60			897
			70			1198
		-10	20			446
			30			431

Table 12. DOWNTOWN EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)

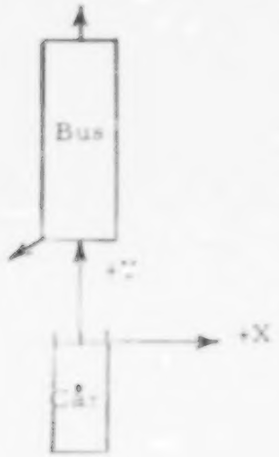
Vehicle: Bus 695, A/C On

Sample Location: Six Probe Manifold, Front of Car

Weather: 76°F, 96% RH, Calm, No wind

Route: See Figure 1

Speed: 15 MPH maximum



Route	Bus	Sample Obtained at (Feet from bus)			Dilution Ratio		
Pattern	Lane	X	Y		Idle	Acceleration	Const Speed
Right	Curb	0	10	Max	617	414	341
				Min	154	234	147
				Average	323	324	263
				RT turn		517	
Right	Curb	0	15	Max	616		480
				Min	247		248
				Average	392		410
				RT turn		601	
Right	Curb	-10	10	Max	116		214
				Min	102		122
				Average	113		156
Left	Center	0	10	Max	286		170
				Min	75		63
				Average	182		124
				Left turn av.		132	
Left	Left Curb	0	10	Max	657	374	328
				Min	92	228	116
				Average	347	317	189
				Left turn av.		89	
Left	Left Curb	0	15	Max	535		285
				Min	209		247
				Average	350	270	266

Sample Probe Located Center of Front Seat head high

Table 12. DOWNTOWN EXHAUST DILUTION RESULTS Page 2.

(Vehicle and Car Both Moving)

Route Pattern	Bus Lane	Sample Obtained at (Feet from bus) X	Y		Dilution Ratio Idle	Acceleration	Const Speed
Right	Curb	0	15	Max	960	839	393
				Min	174	249	215
				Average	462	485	272

Note: The above run with sample probe in center of front seat head high.

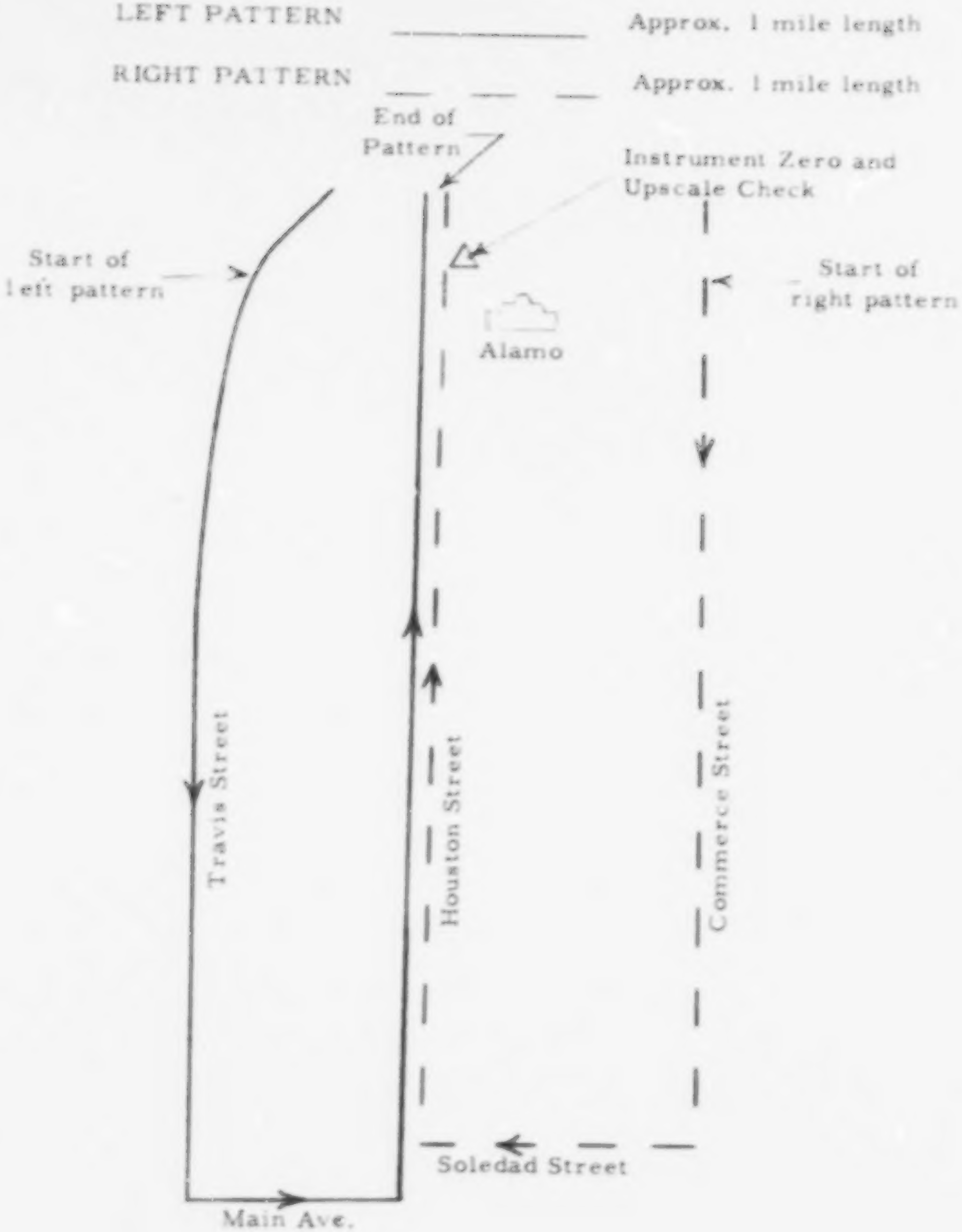
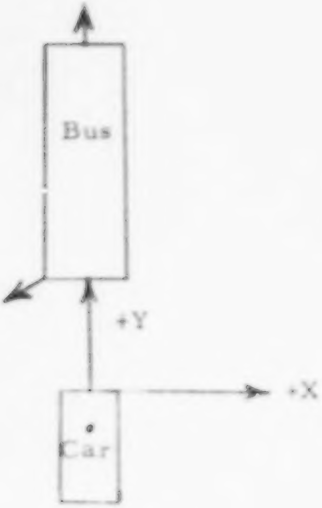


Figure 1. DOWNTOWN SAN ANTONIO EXHAUST DILUTION SURVEY DRIVING ROUTES

Table 13. WOODLAWN BUS LINE EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)

Vehicle:	Bus 695, A/C On
Sample Location:	Six Probe Manifold, Front of car
Weather:	84° F, 76% RH, Calm, 0-1 MPH Wind Variable, Mostly SSE
Route:	Woodlawn Bus Line from Downtown to end of line



Sample Obtained at (Feet from Bus)			Dilution Ratio			
X	Y		Idle	Acceleration	Const Speed	@ MPH
0	10	Maximum	420	224	241	15
(Mostly downtown)		Minimum	105	79	176	
		Average	277	145	208	
0	15	Maximum	1175	600	577	15
(Residential)		Minimum	123	322	288	
		Average	670	503	405	
0	20	Typical			740	10
0	30	Typical			562	
0	15	Typical	1750		295	20
0	20	Maximum	583	683		
		Minimum	280	493		
		Average	431	588	420	20
0	25	Typical			586	20
0	30	Typical	673		315	25

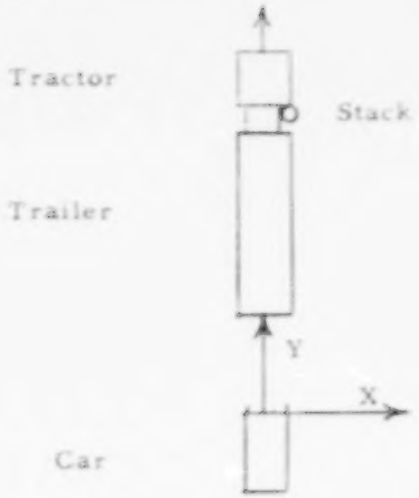
Sample Probe Located Inside Car, middle of Front Seat, head high

Table 13. WOODLAWN BUS LINE EXHAUST DILUTION RESULTS (Page 2)
(Vehicle and Car Both Moving)

Sample Obtained at (Feet from Bus)			Dilution Ratio			
X	Y		Idle	Acceleration	Const Speed	@ MPH
0	30	Maximum	1680	495	530	20
		Minimum	308	334	201	
		Average	695	409	365	
0	30	Typical			430	25
		Typical			850	30
0	20	Maximum	1070	421	718	15
		Minimum	112	267	622	
		Average	591	331	670	
0	20	Typical			740	20
0	20	Maximum			338	25
		Minimum			228	
		Average			283	

Note: The above data obtained with sample probe located in the center of the front seat head high.

Table 14. STATIC EXHAUST DILUTION RESULTS
(Vehicle and Car Stationary)



Vehicle: Tractor-Trailer Truck

Sample Location: 6 Probe Manifold, Front of Car

Weather: 68°F, 94% RH, Calm, No Wind

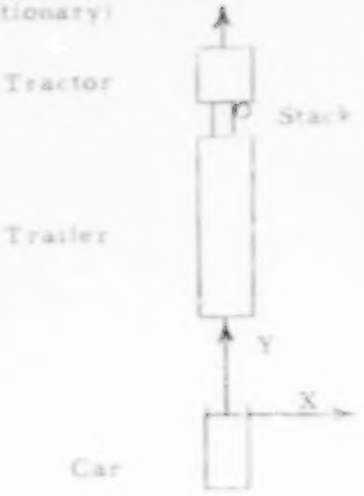
Route: Truck-Trailer and Car Located in Parking lot. Dilution measured at various engine speeds.

Engine Speed RPM	Sample Obtained at (Feet from Trailer) X	Sample Obtained at (Feet from Trailer) Y	Dilution Ratio	Sample Obtained at (Feet from trailer) X	Sample Obtained at (Feet from trailer) Y	Dilution Ratio
480	0	15	4000	10	-45	1745
1150			3920			3045
1730			6300			2650
2300			5490			5230
480	0	35	3025	10	-35	2160
1150			2745			2345
1730			1999			1993
2300			1690			2070
480	0	55	4725	10	-15	4320
1150			3820			7050
1730			2990			4795
2300			10980			4990
480	10	-55	3240	10	5	3710
1150			2820			5425
1730			2500			7970
2300			2745			3665
480	-10	-55	5185	-10	-15	3710
1150			3810			2765
1730			2725			4605
2300			2965			3790

Table 14. STATIC EXHAUST DILUTION RESULTS Page 2
(Vehicle and Car Stationary)

Engine Speed RPM	Sample Obtained at (Feet from trailer) X	Sample Obtained at (Feet from trailer) Y	Dilution Ratio	Sample Obtained at (Feet from trailer) X	Sample Obtained at (Feet from trailer) Y	Dilution Ratio
480	-10	-45	2590	-10	5	4635
1150			2310			12820
1730			3070			3992
2300			2615			4220
480	-10	-35	2645			
1150			2170			
1730			4125			
2300			3140			

Table 15. STATIC EXHAUST DILUTION RESULTS
(Vehicle and Car Stationary)



Vehicle:	Tractor-Trailer Truck
Sample Location:	Single Probe in Center of Front seat of car, head high - All windows down and vents open
Weather:	68°F, 94% RH, Calm, No Wind
Route:	Truck-Trailer and Car located in Parking Lot. Dilution measured at various engine speeds

Engine Speed RPM	Sample Obtained at (Feet from trailer)		Dilution Ratio	Sample Obtained at (Feet from trailer)		Dilution Ratio
	X	Y		X	Y	
480	0	15	6,050	10	-55	4,175
1,150			5,075			4,860
1,730			4,420			7,035
2,300			1,690			7,845
480	0	35	6,100	10	-45	2,595
1150			3,422			6,520
1730			2,390			3,425
2300			2,195			10,980
480	0	55	11,800	-10	-55	3,238
1150			7,050			7,425
1730			5,200			4,425
2300			6,865			3,665
480	-10	-45	4,465			
1150			3,810			
1730			7,970			
2300			4,225			

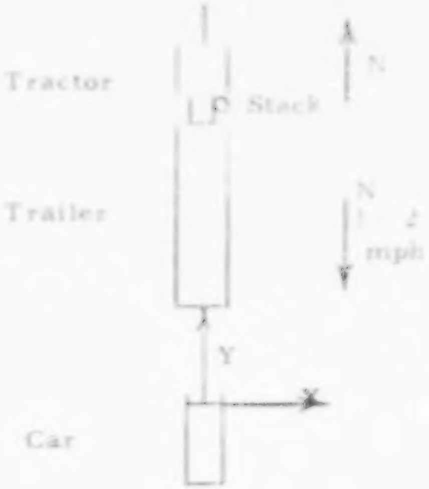
Table 16. CONSTANT SPEED EXHAUST DILUTION RESULTS
(Vehicle and Car Both Moving)

Vehicle: Tractor-Trailer Truck

Sample Location: Six Probe Manifold on Front of car

Weather: 86°F, 61% RH, Slight Breeze 1-2 mph out of North

Route: North-South on Level Loop 410 and Loop 410 access roads.



Run Direction	Sample Obtained at (Feet from trailer) X	Y	Vehicle Speed MPH	Dilution Ratio
N	0	10	10	1,009
	0	20	10	1,185
	0	30	10	1,297
	0	40	10	910
	0	50	10	780
	0	60	10	1,090
	0	80	10	1,515
N	10	-60	10	∞
	10	-50	10	2,725
	10	-40	10	780
	10	-30	10	910
	10	-20	10	910
	10	-10	10	780
	10	0	10	545
	10	20	10	606
	10	40	10	682
	10	60	10	930
N	-10	-60	10	3,090
	-10	-40	10	1,363
	-10	-20	10	910
	-10	0	10	974
	-10	20	10	1,090
	-10	40	10	1,432
	-10	60	10	1,600
	-10	80	10	2,270

Table 16. CONSTANT SPEED EXHAUST DILUTION RESULTS Page 2
(Vehicle and Car Both Moving)

Run Direction	Sample Obtained at (Feet from trailer) X	Y	Vehicle Speed MPH	Dilution Ratio
N	0	20	20	934
	0	40	20	1,400
	0	60	20	2,332
	0	80	20	2,800
N	10	-60	20	∞
	10	-40	20	1,410
	10	-20	20	707
	10	0	20	942
	10	20	20	1,129
	10	40	20	512
	10	60	20	707
	10	80	20	1,005
N	-10	-60	20	∞
	-10	-40	20	1,410
	-10	-20	20	2,119
	-10	0	20	1,410
	-10	20	20	1,879
	-10	40	20	942
	-10	60	20	707
	-10	80	20	1,410
E	0	10	30	1,210
	0	20	30	830
	0	30	30	580
	0	40	30	674
	0	50	30	725
	0	60	30	1,450
	0	80	30	5,800
	0	100	30	∞
	0	120	30	∞
S	0	10	40	1,420
	0	20	40	948
	0	30	40	812
	0	40	40	730
	0	50	40	1,050

Table 16. CONSTANT SPEED EXHAUST DILUTION RESULTS Page 2

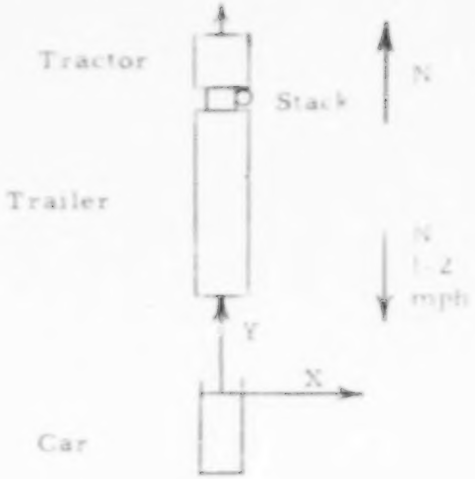
(Vehicle and Car Both Moving)

Run Direction	Sample Obtained at (Feet from trailer) X	Y	Vehicle Speed MPH	Dilution Ratio
S	0	60	40	1,135
	0	70	40	1,289
	0	80	40	1,050
	0	100	40	1,575
N	0	10	50	1,493
	0	20	50	812
	0	30	50	757
	0	40	50	1,890
	0	50	50	2,365
	0	60	50	2,835
	0	80	50	5,670
	0	100	50	9,480
S	0	10	60	735
	0	20	60	659
	0	30	60	840
	0	40	60	613
	0	60	60	980
	0	80	60	2,940
	0	100	60	2,100
	0	120	60	2,940
	0	140	60	3,675

Table 17 CONSTANT SPEED EXHAUST DILUTION RESULTS

(Vehicle and Car Both Moving)

Vehicle:	Tractor-Trailer Truck
Sample Location:	Single Probe in Center of front seat of car head high - all windows down and vents open
Weather:	91°F, 39% RH, Slight Breeze 1-2 mph out of North
Route:	North-South on Level Loop 410 and Loop 410 access roads



Run Direction	Sample Obtained at (Feet from trailer) X	Sample Obtained at (Feet from trailer) Y	Vehicle Speed MPH	Dilution Ratio
N	0	10	10	∞
	0	20	10	1,495
	0	30	10	1,963
	0	40	10	1,652
	0	50	10	2,615
	0	60	10	3,140
	0	80	10	3,485
	0	100	10	6,270
N	10	60	10	∞
	10	-40	10	1,963
	10	-20	10	1,255
	10	0	10	2,855
	10	20	10	2,615
	10	40	10	2,415
	10	60	10	3,925
	10	80	10	2,615
	10	100	10	2,415
N	10	60	10	10,450
	10	40	10	2,092
	10	-20	10	4,485
	10	0	10	1,963

Table 17. CONSTANT SPEED EXHAUST DILUTION RESULTS Page
(Vehicle and Car Both Moving)

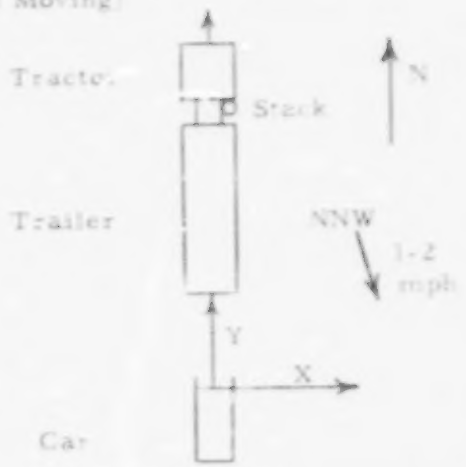
Run Direction	Sample Obtained at (Feet from trailer) X	Y	Vehicle Speed MPH	Dilution Ratio
N	-10	20	10	3,140
	-10	40	10	1,652
	-10	60	10	2,092
	-10	80	10	1,428
	-10	100	10	1,963
S	0	10	20	3,119
	0	20	20	4,701
	0	30	20	∞
	0	40	20	3,119
	0	60	20	4,035
	0	80	20	1,665
	0	100	20	1,765
S	10	-60	20	∞
	10	-40	20	2,820
	10	-20	20	1,410
	10	0	20	1,128
	10	20	20	5,264
	10	40	20	1,410
	10	60	20	1,227
S	-10	-60	20	∞
	-10	-40	20	2,820
	-10	-20	20	7,050
	-10	0	20	1,410
	-10	20	20	1,880
	-10	40	20	1,282
	-10	60	20	1,410
N	0	20	30	1,352
	0	40	30	2,500
	0	60	30	2,038
	0	80	30	2,400
	0	100	30	5,750
	0	120	30	9,590
	0	140	30	∞

Table 17. CONSTANT SPEED EXHAUST DILUTION RESULTS Page 3.

(Vehicle and Car Both Moving)

Run Direction	Sample Obtained at (Feet from trailer) X	Sample Obtained at (Feet from trailer) Y	Vehicle Speed MPH	Dilution Ratio
S	0	10	40	1, 295
	0	20	40	952
	0	30	40	816
	0	40	40	1, 678
	0	60	40	1, 140
	0	80	40	4, 750
	0	100	40	2, 035
	0	120	40	2, 850
	0	140	40	3, 170
N	0	20	50	2, 195
	0	40	50	760
	0	60	50	3, 170
	0	80	50	1, 782
	0	100	50	2, 035
	0	120	50	1, 782
	0	140	50	1, 295
S	0	20	60	2, 418
	0	40	60	1, 525
	0	60	60	1, 073
	0	80	60	1, 450
	0	100	60	1, 705
	0	120	60	937
	0	140	60	968

Table 18. IDLE-ACCELERATION EXHAUST DILUTION RESULTS
(Vehicle and Car Both Moving)



Vehicle: Tractor-Trailer Truck

Sample Location: See Below

Weather: 92°F, 31% RH, Wind Slight 1-2 mph from NNW

Route: Normal acceleration to 60 mph on level North-South Loop 410

Run Direction	Vehicle Speed MPH	Sample Obtained at (Feet behind trailer) Y	Dilution Ratio Probe Manifold in front of car	 Single Probe inside car
N	0 (Idle)	20	5,570	∞
	0-60 Acc.			
	at 20	20	1,350	1,825
	at 40	20	730	1,040
	at 60	20	580	834
N	0 (Idle)	40	1,480	∞
	0-60 Acc.			
	at 20	40	1,000	1,690
	at 40	40	964	823
	at 60	40	1,120	1,485
S	0 (Idle)	20	4,320	∞
	0-60 Acc.			
	at 20	60	2,250	2,475
	at 40	60	1,285	2,285
	at 60	60	1,019	2,525
S	0 (Idle)	100	4,900	∞
	0-60 Acc.			
	at 20	100	1,800	2,846
	at 40	100	730	2,781
	at 60	100	1,450	2,742

Note: Acc. means acceleration.

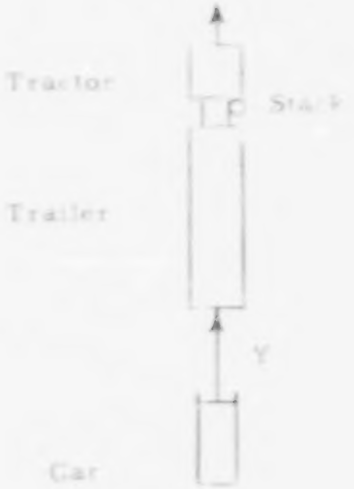
Table 19. TYPICAL TRUCK ROUTE EXHAUST DILUTION RESULTS
(Vehicle and Car Both Moving)

Vehicle: Tractor-Trailer Truck

Sample Location: 6-Probe Manifold Mounted on front of car.

Weather: 76°F, 79% RH.
Calm, No Wind

Route: U.S. Highway 90 Truck Route Eastbound from West outskirts through center city to east edge of residential area and return westbound.



Direction	Route Portion	Truck Speed MPH	Sample Obtained at (Feet behind trailer) Y	Dilution Ratio
E	Residential	20	20	2,070
		20	30	1,425
		20	40	1,782
		20	50	2,415
		30	50	1,093
		30	40	1,282
		30	20	1,750
		30	30	1,352
		30	40	1,552
		30	60	1,282
		30-0 Dec.	30	2,670
		0	30	8,275
		0-30 Acc.	30	1,470
		30	30	1,845
		30	40	1,105
		30	50	1,552
		30-0 Dec.	50	1,712
E	Residential	0	40	1,510
		0-30 Acc.	20	1,712
		30	20	1,190
		30	30	852

Note: ACC. means Acceleration.
DEC. means Deceleration.

Table 19. TYPICAL TRUCK-ROUTE EXHAUST DILUTION RESULTS Page 2
(Vehicle and Car Both Moving)

Direction	Route Portion	Truck Speed MPH	Sample Obtained at (Feet behind trailer) Y	Dilution Ratio
E	Residential	30	30	1,210
		30-0 Dec.	30	1,340
		0	30	4,725
		0-20 Acc.	30	1,143
		20	20	980
		20	30	947
E	Center City	0	20	∞
		0-15 Acc.	20	1,930
		15	20	1,478
		15-0 Dec.	20	1,815
		0	20	4,735
		0-10 Acc.	20	2,375
		10	100	5,520
		10	20	3,683
		0	20	∞
		0-10 Acc. Left Turn	20	1,932
		10-0 Dec.	20	2,380
		0	20	5,510
		0-15 Acc. Right Turn	20	2,810
		15	20	1,315
		0	20	4,720
		0-15 Acc.	30	1,262
		15	30	1,280
		10	30	1,655
		0	20	∞
		0-10 Acc. Left Turn	20	1,630
		10 Right Turn	20	1,862
E	Expressway Outbound	10-30 Acc.	20	1,472
		30	20	1,440
		30	30	895
		30	30	665
		30	30	527
		30	40	764

Table 19. TYPICAL TRUCK-ROUTE EXHAUST DILUTION RESULTS Page 3
(Vehicle and Car Both Moving)

Direction	Route Portion	Truck Speed MPH	Sample Obtained at (Feet behind Trailer) Y	Dilution Ratio
W	Inbound Residential	0	20	∞
		0-20 Acc.	20	1,262
		20	20	1,588
		20	30	1,360
		20-0 Dec.	30	1,932
W	Center City	0	30	∞
		0-15 Acc.	30	2,210
		15	30	1,240
		15	40	2,170
		15-0 Dec.	40	1,932
		0	40	11,830
		0-15 Acc.	40	2,380
		15	40	1,300
		15-0 Dec.	40	1,932
W	Outbound Residential	0	40	17,750
		0-20 Acc.	40	1,545
		20	40	1,495
		25	40	719
		30	40	1,805
		30-0 Dec.	40	1,345
		0	40	7,890
		0-20 Acc.	40	2,575
		20	40	1,775
		20-0 Dec.	40	2,575
		0	40	∞
		0-20 Acc.	40	2,380
W	Residential Outbound	20	40	1,895
		30	40	1,730
		30-0 Dec.	40	3,090
		0	40	∞
		0-20 Acc.	40	1,932
		20	40	926
		30	40	1,173
		30	35	738
		20	35	993
		20-0 Dec.	35	1,820
		0	35	∞
		0-30 Acc.	35	1,238
		30	35	1,918

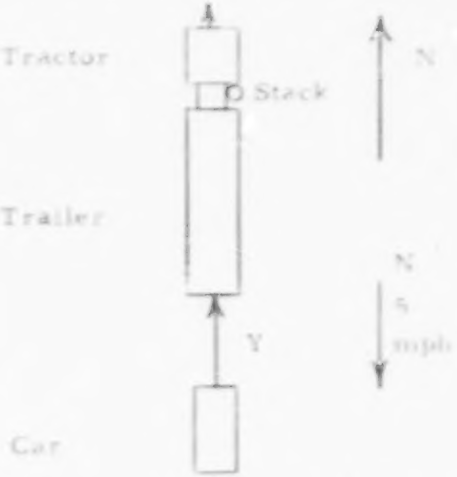
Table 20. EXHAUST DILUTION DATA - EXPRESSWAY OPERATION
(Vehicle and Car Both Moving)

Vehicle: Tractor-Trailer Truck

Sample Location: See Below

Weather: 91°F, 56% RH
Wind out of North at 5 mph

Route: Northwest-Southeast over
crowded IH 35 Expressway
(Numerous overpasses and walls)



Run Direction	Vehicle Speed MPH	Sample Obtained at (Feet behind trailer) Y		Dilution Ratio	
				Probe Manifold in front of car	Single Prob inside car
NW	40	40	Maximum	936	4,620
			Minimum	468	678
			Average	748	1,941
SW	40	60	Maximum	5,420	6,750
			Minimum	542	656
			Average	1,367	2,132
SW	50	50	Maximum		27,750
			Minimum		925
			Average		4,482
NW	50	60	Maximum	1,850	
			Minimum	505	
			Average	1,159	
SW	50	80	Maximum	3,080	
			Minimum	505	
			Average	1,473	

Note: Average Dilution Ratio

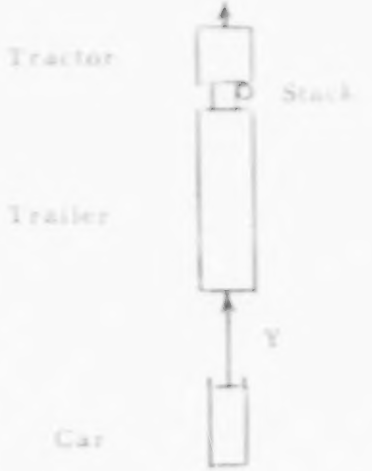
Table 21. DOWNTOWN EXHAUST DILUTION RESULTS
(Vehicle and Car Both Moving)

Vehicle: Tractor-Trailer Truck

Sample Location: See Below

Weather: 78°F, 80% RH,
Calm, No Wind

Route: Center City - Business
and Shopping District
(Not through Truck Route)
See Figure 2 for details.



Vehicle Speed MPH	Sample Obtained at (Feet behind trailer) Y		Dilution Ratio	
			Probe Manifold in front of car	Single Probe inside car
0 Idle	20	Maximum	16,500	18,200
		Minimum	4,115	11,900
		Average	9,480	15,570
0-10 Acc	20	Maximum	3,420	5,150
		Minimum	1,405	3,420
		Average	2,413	4,265
0-15 Acc	20	Maximum	2,810	3,430
		Minimum	1,405	2,205
		Average	1,877	2,672
0-20 Acc	20	Maximum	2,575	2,810
		Minimum	1,105	2,380
		Average	1,789	2,595
15	20	Maximum	3,010	4,125
		Minimum	1,365	2,070
		Average	2,188	2,956

Note: Acc means acceleration.
Dec means deceleration.

Table 21. DOWNTOWN EXHAUST DILUTION RESULTS
(Vehicle and Car Both Moving)

Vehicle Speed MPH	Sample Obtained at (Feet behind trailer) Y		Dilution Ratio	
			Probe Manifold in front of car	Single Prob inside car
20	20	Maximum	1,358	3,145
		Minimum	1,045	1,965
		Average	1,166	2,460
20-0 Dec.	20	Maximum	7,725	5,150
		Minimum	2,180	3,090
		Average	5,052	4,218
0	30	Maximum	17,850	17,400
		Minimum	3,000	8,650
		Average	11,300	13,450
0-20 Acc.	30	Maximum	4,775	
		Minimum	1,590	
		Average	3,183	2,535
0-15 Acc.	30	Maximum	3,425	3,860
		Minimum	1,342	1,820
		Average	1,986	2,678
15	30	Maximum	2,665	3,040
		Minimum	1,195	1,680
		Average	1,837	2,345
20	30	Maximum	1,715	2,115
		Minimum	1,310	1,825
		Average	1,411	1,970
20-0 Dec.	30	Maximum	10,300	[illegible]
		Minimum	2,305	1,030
		Average	5,979	1,882

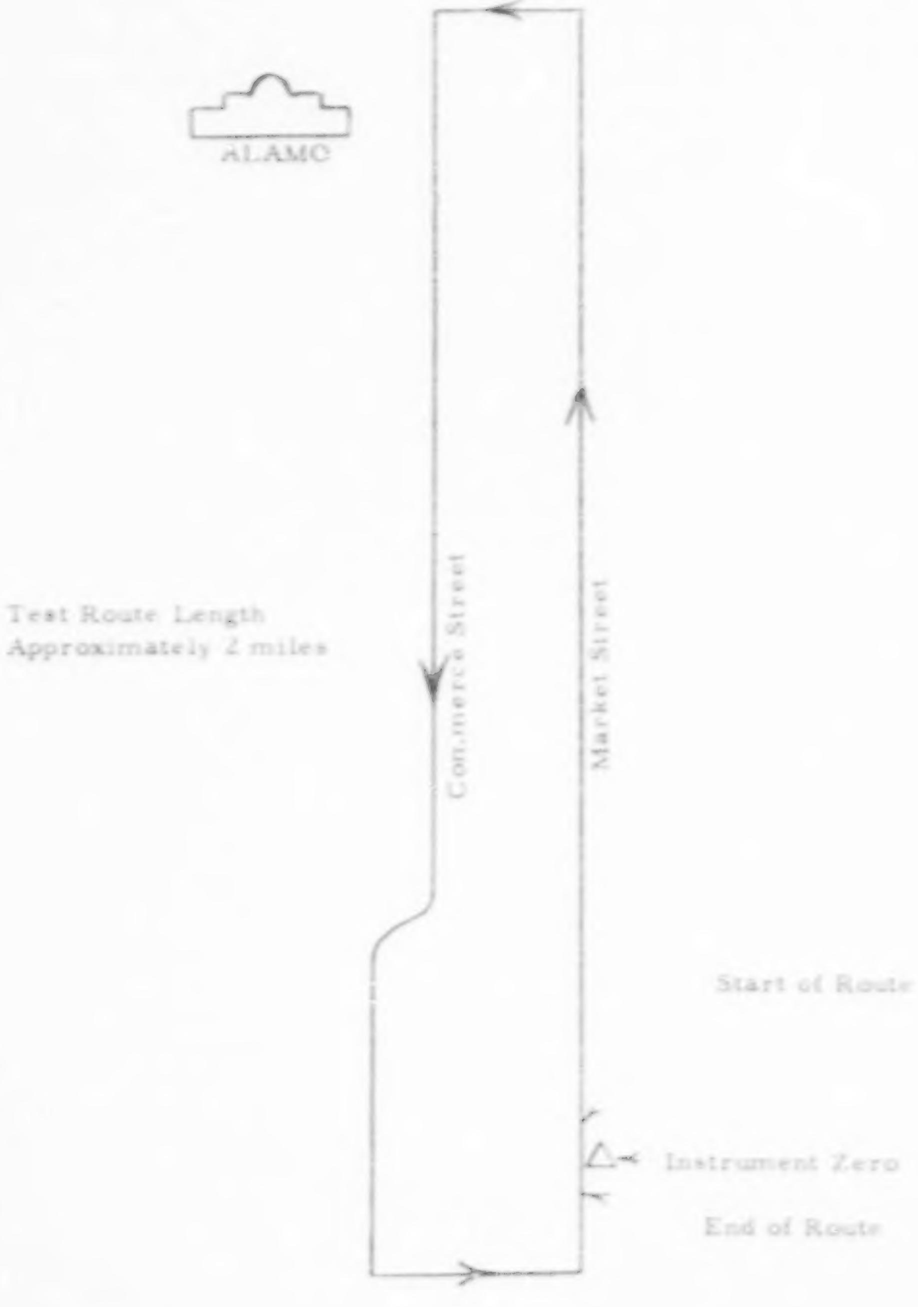


Figure 2. DOWNTOWN SAN ANTONIO EXHAUST DILUTION SURVEY DRIVING ROUTE (TRUCK)

APPENDIX C

LABORATORY ODOR AND SMOKE PROCEDURAL DEVELOPMENT RESULTS

(Municipal Bus)

Table 1. PROCEDURAL DEVELOPMENT EXPERIMENTAL SERIES FOR ODOR QUALITY/INTENSITY MEASUREMENT (MUNICIPAL BUS)

Experimental Series No.	Type of Operation	Speed mph	Load Range hp	Dilution Range
1. (Exploratory)	Constant Speed (Training)	0-30	0-40	100:1 - 480:1
2. (Exploratory)	Constant Speed (Training)	0-40	0-30	133:1 - 800:1
3. (Exploratory	Idle-Acceleration (Training)	0-35	20-30 at 30 mph	200:1 - 800:1
4. (Exploratory)	Constant Speed (Training)	0-40	0-40	200:1 - 800:1
5. (Exploratory)	Idle-Acceleration (Training)	0-30	0-30 at 30 mph	200:1 - 800:1
6.	Constant Speed	40	0-40	200:1 - 800:1
7.	Constant Speed Constant Speed-Deceleration	30 40-0	0-30 0-40 at 40 mph	200:1 - 800:1
8.	Idle-Acceleration Constant Speed	0-30 30	0-30 at 30 mph 0-30	200:1 - 800:1 100:1 - 1000:1
9.	Constant Speed	30	0-30	100:1 - 1000:1
10.	Idle-Acceleration	0-30	0-30 at 30 mph	100:1 - 1000:1
11.	Constant Speed	20	0-40	100:1 - 1000:1

Table I (cont'd)

Experimental Series No.	Type of Operation	Speed mph	Load Range hp	Dilution Range
12.	Constant Speed-Deceleration	40-0	0-40 at 40 mph	100:1 - 1000:1
13.	Constant Speed	40	0-40	100:1 - 1000:1
14.	Idle-Acceleration	0-35	0-30 at 30 mph	100:1 - 1000:1
15.	Constant Speed	30	0-40	100:1 - 1000:1
16.	Idle-Acceleration	0-35	0-30 at 30 mph	110:1 - 1400:1
17.	Constant Speed-Deceleration	40-0	0-40 at 40 mph	100:1 - 2650:1
18.	Mixed Conditions	0-40	30-40	100:1 - 1000:1
19.	Mixed Conditions	0-40	30-40	100:1 - 1000:1
20.	Mixed Conditions	0-40	30-40	100:1 - 1000:1
21.	Idle-Hot	0	0-40	100:1 - 1000:1
22.	Idle-Hot	0	0-40	100:1 - 1000:1
23.	Mixed Conditions	0-40	0-40	100:1 - 1000:1
24.	Mixed Conditions	0-40	0-40	100:1
25.	Mixed Conditions	0-40	0-40	100:1

Table 1A. CONSTANT SPEED DIESEL ODOR QUALITY/INTENSITY DIESEL ODOR EVALUATION PROCEDURE

(Tentative)

Applicability: GM Truck and Coach Model 4519 City Bus powered by Detroit Diesel 6V-71 engine.

Sample Method: Constant sample flow using a separate orifice for 100:1, 300:1, and 1000:1 dilution levels.

Warm-up: A minimum of three complete runs should be conducted prior to odor evaluation to assure the engine and system have reached operating temperature.

Speeds and Loads: The following are suggested:

Vehicle (1) Speed, mph	Engine Speed, ~~mph~~ rpm	Vehicle (2) Load, hp	Power Level
20	890	40	near max. rack
30	1200	40	2/3 rack
40	1590	40	2/3 rack

(1) Transmission in "Drive" Range.
(2) With full bus inertia simulation, air conditioning "off".

Procedure:

(1) Operate at given stable speed and load for 15 seconds.
(2) Turn "on" 45-second panel warning light, turn dilution system to "auto" control, and continue stable operation.
(3) Ring bell for panel to begin odor evaluation and maintain stable operation.
(4) Panel turns "off" light when evaluation is complete. The evaluation requires 50-70 seconds to complete.

(Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with 2 to 3 exposures (sniffs) at will during the approximately 60-second period.

(5) When light is "off", turn dilution system to "man" control, and decelerate to idle. Permit rear tires to rotate and cool.
(5) Wait 5 minutes between runs for panel rest, tire cooling, orifice change. (Time starts when light goes "out".)

Run Time: Approximately -- 3 minutes; with 5-minute rest -- 8 minutes.

Table 1B. IDLE-ACCELERATION DIESEL ODOR QUALITY/INTENSITY DIESEL ODOR EVALUATION PROCEDURE (Tentative)

Applicability:	GM Truck and Coach Model 4519 Bus powered by Detroit Diesel 6V-71 engine
Sample Method:	Constant sample flow using a separate orifice for 100:1, 300:1, and 1000:1 dilution levels
Warm-up:	A minimum of three complete runs should be conducted prior to odor evaluation to assure the engine and system have reached operating temperature
Inertia Simulation:	Full inertia simulation via SwRI system
Vehicle Speed:	Idle for 1 minute followed by full rack acceleration to 35 mph
Vehicle Load:	30 hp initially impressed at 30 mph and retained in water-brake-type dynamometer. Air conditioning "off"
Procedure:	(1) Turn "on" 60-second panel warning light; turn dilution system to "auto" and idle for 1 minute (rear wheels stationary). (2) Accelerate full rack to 35 mph with previously impressed 30 hp load at 30 mph and full inertia simulation. (3) Ring bell for panel exposure "a" 3 seconds after start of acceleration. (4) Ring bell for panel exposure "b" 3 seconds after engine upshift. (5) Ring bell for panel exposure "c" on reaching 35 mph. (6) Hold 35 mph for 15 seconds; turn dilution system to "man" and decelerate to rest. Turn "off" light. (7) When downshift occurs, turn off engine and allow rear tires to come to rest. (8) Two minutes after downshift above, start engine and allow to idle. Turn on 60-second panel warning light and turn dilution system to "auto". Allow engine to idle for 1 minute (rear wheels stationary). (9) Repeat items (2) through (7) above. The original and repeat idle acceleration constitute one run.

Table 13 (cont'd)

(10) Wait 5 minutes between runs for panel rest, tire cooling, and orifice change. (Time starts on engine downshift.)

(Note. The panel evaluates the dilute diesel exhaust sample for the overall diesel composite, and each of the four qualities with only an original and a repeat exposure (sniff) at each of the three times during the acceleration.)

Run Time: Approximately -- 6.5 minutes, with 5-minute rest -- 11.5 minutes.

Table 1C. CONSTANT SPEED-DECELERATION DIESEL ODOR QUALITY/ INTENSITY DIESEL ODOR EVALUATION PROCEDURE

(Tentative)

Applicability:	GM Truck and Coach Model 4519 City Bus powered by Detroit Diesel 6V-71 engine.
Sample Method:	Constant sample flow using a separate orifice for 100:1, 300:1, and 1000:1 dilution levels.
Warm-up:	A minimum of three complete runs should be conducted prior to odor evaluation to assure the engine and system have reached operating temperature.
Inertia Simulation:	Full inertia simulation via SwRI system.
Vehicle Speed and Load:	Operate at stable 40 mph and 40 hp for 1 minute followed by closed-rack deceleration with full inertia simulation, air conditioning "off".
Procedure:	(1) Operate at 40 mph and 40 hp, stable. (2) Turn "on" 60-second panel warning light, turn dilution system to "auto" and maintain stable operation. (3) After one minute of stable sustained operation, closed-rack deceleration to downshift. (4) Ring bell for panel exposure "a" 5 seconds after start of deceleration. (5) Ring bell for panel exposure "b" 25 seconds after start of deceleration. (6) Ring bell for panel exposure "c" at downshift (17 mph). (7) Permit engine to idle and cool tires. Turn "off" light and turn dilution system to "man". (8) Two minutes after downshift, return to 40 mph and 40 hp condition. (9) Repeat items (2) through (7) above. The original and repeat constant speed-deceleration constitute one run. (10) Wait 5 minutes between runs for panel rest, tire cooling, and orifice change. (Time starts on engine downshift). (Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with only an original and a repeat exposure (sniff) at each of the 3 times during the deceleration.
Run Time:	Approximately -- 7 minutes; with 5-minute rest -- 12 minutes.

position 10

SOUTHWEST RESEARCH INSTITUTE
DATA SHEET

SUBJECT Odor Quality/Intensity Evaluation

SHEET NO. 1 OF 2 SHEETS
PROJECT 10-1867
DATE 11/22/66
BY Joyce Cole

TABLE 1D. REPRESENTATIVE DATA SHEET FROM SERIES 19 EXPERIMENTS

		Odor Quality/ Intensity Rating				
Run Number	Diesel Composite "D"	First Most Obvious	Second Most Obvious	Third Most Obvious	Fourth Most Obvious	Comments
Constant 1.	6	B^1	O^1	A^1	P^0	
2	7	B^2	O^2	A^1	P^0	break
Trans 3 a	6	B^2	O^2	A^1	P^0	
change b	6	B^2	O^2	A^0	P^1	b+c have a
c	6	B^2	O^2	A^0	P^1	terrible odor
Constant 4	5	B^1	O^1	A^1	P^0	(sweet)
Trans 5 a	4	B^1	O^1	A^1	P^0	
b	4	B^1	O^1	A^1	P^0	
c	4	B^1	O^1	A^1	P^0	
6.	6	B^2	O^2	A^1	P^0	
Trans 7. a	6	A^2	P^1	O^1	B^1	
b	6	A^2	P^1	O^1	B^1	change
c	6	A^2	P^1	O^1	B^1	lunch
Constant 8.	4	B^1	O^1	A^1	P^0	
9.	5	B^1	O^1	A^1	P^0	sweet
10.	4	B^2	O^1	A^1	P^1	
Trans 11. a	4	B^1	A^1	O^1	P^0	
b	4	B^1	A^1	O^1	P^0	
c	4	B^1	A^1	O^1	P^0	
Cont. 12.	7	B^2	O^2	A^1	P^0	

Appendix C
Page 8

position 10

SOUTHWEST RESEARCH INSTITUTE
DATA SHEET

SHEET NO. 2 OF 2 SHEETS
PROJECT 10-1867
SUBJECT Odor Quality/Intensity Evaluation
DATE 11-22-66
BY Joyce Cole

TABLE ID. REPRESENTATIVE DATA SHEET FROM SERIES 19 EXPERIMENTS Page 2

		Odor Quality/ Intensity Rating				
Run Number	Diesel Composite "D"	First Most Obvious	Second Most Obvious	Third Most Obvious	Fourth Most Obvious	Comments
13. a.	6	B^2	O^2	A^1	P^1	
b.	6	B^2	O^2	A^1	P^1	
c.	6	B^2	O^2	A^1	P^1	
14	5	B^1	O^1	A^1	P^0	sweet
15.	6	B^2	O^2	A^1	P^0	
16 a	7	B^2	A^2	O^2	P^1	
b	7	B^2	A^2	O^2	P^1	odd odor
c	6	B^2	A^2	O^2	P^1	
17. a.	5	B^1	O^1	A^1	P^0	
b.	4	B^1	O^1	A^1	P^0	
c	4	B^1	O^1	A^1	P^0	
18.	7	B^2	O^2	A^1	P^0	

TABLE 2. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
2(2)	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.(2)	800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.	200	40	0	6	4	5.5	3	1	0.2	3	1	1.7	2	0	1.0	1	0	0.2
3.	800	40	0	5	3	4.0	2	1	0.1	2	1	1.1	2	0	0.9	1	0	0.2
5.	800	40	0	4	2	2.7	1	1	1.0	1	0	0.5	2	0	0.8	0	0	0
						3.4			0.5			0.8			0.8			0.1
6.	800	40	40	1	0	0.9	1	0	0.4	1	0	0.2	2	0	0.4	0	0	0
7.	800	40	40	3	1	2.2	1	0	0.8	1	0	0.5	1	0	0.5	0	0	0
8.	800	40	40	6	4	5.3	3	1	1.6	2	1	1.4	2	0	0.9	1	0	0.3
						2.8			1.4			0.7			0.6			0.1

(1) Constant Sampling

(2) Runs 1 and 2 with no diesel sample, dilution air only.

TABLE 2A. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: October 31, 1966

Type Operation: Constant Speed
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite Responses 0	1	2	3	4	5	6	Ave.
1.	0	0	800	13		Engine	"off"				0
2.	0	0	200	13		Engine	"off"				0
3.	40	0	800				3	7	3		4.0
4.	40	0	200					1	4	8	5.5
5.	40	0	800			5	7	1			2.7
6.	40	40	800	8		4	1				0.9
7.	40	40	800		2	7	4				2.2
8.	40	40	800					1	7	5	5.3

TABLE 2B. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: October 31, 1966

Type Operation: Constant Speed
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"B" Standard Responses 0	1	2	3	Ave.
1.	0	0	800	13	Engine	"off"		0
2.	0	0	200	13	Engine	"off"		0
3.	40	0	800		8	5		0.1
4.	40	0	200		3	9	1	0.2
5.	40	0	800		13			1.0
6.	40	40	800	8	5			0.4
7.	40	40	800	3	10			0.8
8.	40	40	800		6	6	1	1.6

TABLE 2C. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: October 31, 1966

Type Operation: Constant Speed
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"0" Standard Responses 0	1	2	3	Average
1.	0	0	800	13	Engine "off"			0
2.	0	0	200	13	Engine "off"			0
3.	40	0	800		12	1		1.1
4.	40	0	200		5	7	1	1.7
5.	40	0	800	7	6			0.5
6.	40	40	800	11	2			0.2
7.	40	40	800	7	6			0.5
8.	40	40	800		8	5		1.4

TABLE 2D. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: October 31, 1966

Type Operation: Constant Speed
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"A" Standard Responses 0	1	2	Average
1.	0	0	800	13	Engine "off"		0
2.	0	0	200	13	Engine "off"		0
3.	40	0	800	3	9	1	0.9
4.	40	0	200	2	9	2	1.0
5.	40	0	800	5	6	2	0.8
6.	40	40	800	9	3	1	0.4
7.	40	40	800	7	6		0.5
8.	40	40	800	3	8	2	0.9

TABLE 2E. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: October 31, 1966

Type Operation: Constant Speed
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"P" Standard Responses 0	1	Average
1.	0	0	800	13	Engine "off"	0
2.	0	0	200	13	Engine "off"	0
3.	40	0	800	10	3	0.2
4.	40	0	200	10	3	0.2
5.	40	0	800	13		0
6.	40	40	800	13		0
7.	40	40	800	13		0
8.	40	40	800	9	4	0.3

TABLE 3. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Constant Speed and Deceleration)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
CONSTANT																		
4.	200	30	0	6	4	5.6	3	1	1.9	2	1	1.5	2	0	1.0	1	0	0.1
7.	200	30	30	7	5	6.2	4	1	2.1	2	0	1.6	2	0	1.0	1	0	0.1
6.	400	30	0	6	3	4.9	3	1	0.9	2	0	1.1	2	0	0.9	1	0	0.1
8.	400	30	0	6	2	5.1	2	1	1.3	2	0	1.1	2	0	0.9	1	0	0.1
						5.0			1.1			1.1			0.9			0.1
5.	400	30	30	7	3	5.6	2	1	1.7	2	0	1.3	2	0	0.9	1	0	0.1
1.	800	30	0	6	0	3.5	2	0	1.1	2	0	0.6	1	0	0.7	0	0	0
3.	800	30	0	5	1	3.2	2	0	1.0	2	0	0.9	2	0	0.9	1	0	0
						3.4			1.1			0.8			0.8			0
2.	800	30	30	6	1	3.7	2	0	1.1	3	0	0.9	2	0	0.1	1	0	0.1
CONSTANT SPEED - DECELERATION																		
11. 0(1)	200	40-0	0	7	5	6.0												
15	200	40-0	0	7	5	5.9												
30	200	40-0	0	7	4	5.3				Tire Trouble								
45	200	40-0	0	6	4	5.4												
60	200	40-0	0	6	3	5.1												
						5.6												
10. 0	200	40-0	30	7	5	5.7	3	1	1.8	2	0	1.6	3	0	1.1	1	0	0.3
15	200	40-0	30	7	5	5.9	3	1	1.9	2	0	1.5	2	0	1.1	2	0	0.4
30	200	40-0	30	7	4	5.2	2	1	1.8	2	0	1.3	2	0	1.1	1	0	0.5
45	200	40-0	30	7	5	5.5	3	1	1.6	2	0	1.1	2	0	1.1	1	0	0.6
60	200	40-0	30	6	4	5.2	2	0	1.4	2	0	1.0	2	0	1.0	1	0	0.5
						5.5			1.7			1.3			1.0			0.5
9. 0	400	40-0	40	8	5	5.8	3	1	2.1	2	0	1.9	2	0	1.3	1	0	0.1
15	400	40-0	40	8	3	5.6	2	1	1.8	2	0	1.9	2	0	1.1	1	0	0.1
30	400	40-0	40	7	3	5.6	3	1	2.0	2	0	1.4	2	0	1.1	1	0	0.2
45	400	40-0	40	7	2	4.7	3	1	1.4	2	0	1.2	2	0	1.2	1	0	0.1
60	400	40-0	40	7	2	4.1	2	1	1.3	2	0	1.2	1	0	1.6	1	0	0.2
						5.2			1.7			1.5			1.2			0.2

(1) Seconds after start of closed rack deceleration.
(2) Load at 40 mph for 1 minute, left in dynamometer during deceleration.

TABLE 3A. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695 — Type Operation: Constant Speed & Deceleration
Sample Method: Constant
Date: November 3, 1966 — Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite Responses) 1	2	3	4	5	6	7	8	Ave.
CONSTANT SPEED												
1.	30	0	800		3	3	3	2	2			3.5
2.	30	30	800	1	1	4	4	3	1			3.7
3.	30	0	800	1	2	6	3	2				3.2
4.	30	0	200				1	3	10			5.6
5.	30	30	400			1		4	8	1		5.6
6.	30	0	400			1	2	8	3			4.9
7.	30	30	200					1	9	4		6.2
8.	30	0	400		1		3	3	7			5.1
CONSTANT SPEED-DECELERATION												
9. 0(1)	40-0	30(2)	400					7	4	2	1	5.8
15	40-0	30	400			1		5	6	1	1	5.6
30	40-0	30	400			2	1	2	5	4		5.6
45	40-0	30	400		2		3	6	1	2		4.7
60	40-0	30	400		1	3	6	2	1	1		4.1
10. 0	40-0	30	200					5	8	1		5.7
15	40-0	30	200					4	7	3		5.9
30	40-0	30	200				1	5	6	2		5.2
45	40-0	30	200					8	5	1		5.5
60	40-0	30	200				3	5	6			5.2
11. 0	40-0	0	200					4	6	4		6.0
15	40-0	0	200					3	9	2		5.9
30	40-0	0	200				3	4	6	1		5.4
45	40-0	0	200				3	2	9			5.4
60	40-0	0	200			1	2	5	6			5.1

(1) - (2) See Table 3 for explanation.

TABLE 3B. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 3, 1966

Type Operation: Constant Speed and Deceleration
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"B" Standard Results 0	1	2	3	4	Average
CONSTANT SPEED									
1.	30	0	800	1	10	3			1.1
2.	30	30	800	1	11	2			1.1
3.	30	0	800	2	10	2			1.0
4.	30	0	200		4	9	1		1.9
5.	30	30	400		4	10			1.7
6.	30	0	400		9	4	1		0.9
7.	30	30	200		1	11	1	1	2.1
8.	30	0	400		10	4			1.3
CONSTANT SPEED-DECELERATION									
9. 0(1)	40-0	30(2)	400		1	11	2		2.1
15	40-0	30	400		3	11			1.8
30	40-0	30	400		2	11	1		1.9
45	40-0	30	400		7	6	1		1.4
60	40-0	30	400		10	4			1.3
10. 0	40-0	30	200		2	11	1		1.8
15	40-0	30	200		4	8	2		1.9
30	40-0	30	200		2	12			1.9
45	40-0	30	200		7	6	1		1.6
60	40-0	30	200	1	6	7			1.4
11.	Tire Trouble								

(1) - (2) See Table 3 for explanation.

TABLE 3C. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 3, 1966

Type Operation: Constant Speed and Deceleration
Fuel: Reference No. 1

Run	Speed	Load	Dilution	"O" Standard Responses				
No.	MPH	HP	Ratio	0	1	2	3	Average
CONSTANT SPEED								
1.	30	0	800	8	3	3		0.6
2.	30	30	800	5	6	2	1	0.9
3.	30	0	800	4	8	2		0.9
4.	30	0	200		7	7		1.5
5.	30	30	400	2	6	6		1.3
6.	30	0	400	2	9	3		1.1
7.	30	30	200	1	3	10		1.6
8.	30	0	400	2	9	3		1.1
CONSTANT SPEED - DECELERATION								
9. 0(1)	40-0	30(2)	400	1	4	9		1.9
15	40-0	30	400	1	5	8		1.9
30	40-0	30	400	1	7	6		1.4
45	40-0	30	400	2	9	4		1.2
60	40-0	30	400	1	11	2		1.0
10. 0	40-0	30	200		6	8		1.6
15	40-0	30	200	1	7	6		1.4
30	40-0	30	200	1	8	5		1.3
45	40-0	30	200	3	8	3		1.0
60	40-0	30	200	3	7	4		1.1
11.	Tire Trouble							

(1) - (2) See Table 3 for explanation.

TABLE 3D. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 3, 1966

Type Operation: Constant Speed and Deceleration
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"A" Standard Responses				
				0	1	2	3	Average
CONSTANT SPEED								
1.	30	0	800	4	10			0.7
2.	30	30	800	3	10	1		0.9
3.	30	0	800	3	9	2		0.9
4.	30	0	200	2	10	2		1.0
5.	30	30	400	3	10	1		0.9
6.	30	0	400	3	9	2		0.9
7.	30	30	200	3	8	3		1.0
8.	30	0	400	3	9	2		0.9
CONSTANT SPEED - DECELERATION								
1. 0(1)	40-0	30(2)	400	1	8	5		1.3
15	40-0	30	400	1	10	3		1.1
30	40-0	30	400	3	10	2		1.0
45	40-0	30	400	3	7	4		1.1
60	40-0	30	400	3	11			1.6
2. 0	40-0	30	200	1	11	1	1	1.1
15	40-0	30	200	2	9	3		1.1
30	40-0	30	200	2	9	3		1.1
45	40-0	30	200	3	6	5		1.1
60	40-0	30	200	4	6	4		1.0

(1) - (2) See Table 3 for explanation.

TABLE 3E. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 3, 1966

Type Operation: Constant Speed and Deceleration
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"P" Standard Responses 0	1	2	Average
CONSTANT SPEED							
1.	30	0	800	14			0
2.	30	30	800	13	1		0.1
3.	30	0	800	13	1		0.1
4.	30	0	200	12	2		0.1
5.	30	30	400	13	1		0.1
6.	30	0	400	13	1		0.1
7.	30	30	200	13	1		0.1
8.	30	0	400	12	2		0.1
CONSTANT SPEED - DECELERATION							
9. 0(1)	40(1)	30(2)	400	13	1		0.1
15	40	30	400	13	1		0.1
30	40	30	400	11	3		0.2
45	40	30	400	12	2		0.1
60	40	30	400	10	4		0.3
10. 0	40	30	200	10	4		0.3
15	40	30	200	10	3	1	0.4
30	40	30	200	7	7		0.5
45	40	30	200	5	9		0.6
60	40	30	200	6	8		0.6

(1) - (2) See Table 3 for explanation.

TABLE 4. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Idle-Acceleration & Constant Speed)

Run No.	Dilution Ratio(2)	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
2. 0(1)	200	0-30	0	6	5	5.4	3	1	1.7	2	0	1.3	2	0	1.1	2	0	0.6
15	200	0-30	0	6	4	5.3	3	1	1.5	2	0	1.1	2	0	1.0	2	0	0.3
30	200	0-30	0	6	3	5.1	2	1	1.5	2	0	1.3	2	0	0.9	1	0	0.1
45	200	C-30	0	6	3	4.9	2	1	1.4	2	0	1.3	2	0	0.7	1	0	0.1
60	200	0-30	0	6	3	4.4	2	1	1.2	2	0	1.1	2	0	0.8	1	0	0.1
						5.0			1.5			1.2			0.9			0.2
1. 0	200	0-30	30(3)	7	4	5.7	4	1	2.8	2	1	1.9	2	0	0.9	1	0	0.2
15	200	0-30	30	7	4	5.8	4	1	2.0	2	0	1.4	2	0	0.9	1	0	0.4
30	200	0-30	30	6	3	5.4	4	1	1.5	2	0	1.2	2	0	1.0	1	0	0.2
45	200	0-30	30	6	3	4.6	2	1	1.2	2	0	1.1	1	0	0.6	1	0	0.3
60	200	0-30	30	5	3	4.4	2	1	1.2	2	0	1.0	1	0	0.7	1	0	0.1
						5.2			2.0			1.3			0.8			0.2
4. 0	800	0-30	0	5	3	4.2	3	0	1.2	2	0	1.3	2	0	0.7	1	0	0.1
15	800	0-30	0	5	3	4.4	3	0	1.2	2	0	1.1	1	0	0.5	1	0	0.1
30	800	0-30	0	5	3	4.4	3	0	1.1	2	0	1.4	1	0	0.2	1	0	0.3
45	800	0-30	0	5	3	3.9	3	0	0.9	2	0	1.1	2	0	0.4	1	0	0.1
60	800	0-30	0	4	1	3.3	3	0	0.6	2	0	0.9	2	0	0.4	1	0	0.1
						4.0			1.0			1.2			0.5			0.1
3. 0	800	0-30	30	6	4	4.8	2	1	1.4	2	0	1.4	1	0	0.3	1	0	0.4
15	800	0-30	30	6	3	4.5	2	1	1.2	2	0	1.3	1	0	0.3	1	0	0.3
30	800	0-30	30	5	3	4.3	2	1	1.1	2	0	1.1	1	0	0.2	1	0	0.1
45	800	0-30	30	5	3	4.0	2	1	1.1	2	0	1.2	1	0	0.2	1	0	0.2
60	800	0-30	30	5	3	3.9	2	1	1.1	2	0	1.1	1	0	0.1	1	0	0.4
						4.3			1.2			1.2			0.2			0.3
CONSTANT SPEED																		
9.	100	30	0	7	0	5.6	3	1	2.0	3	1	1.9	2	0	1.1	1	0	0.3
10.	100	30	30	8	4	6.6	3	1	2.1	3	0	1.9	2	0	1.1	1	0	0.4
6.	1000	30	0	4	1	2.5	1	0	0.9	1	0	0.8	2	0	0.2	1	0	0.1
8.	1000	30	0	3	0	2.1	1	0	0.5	2	0	0.8	1	0	0.1	0	0	0
						2.3			0.7			0.8			0.2			0.0
5.	1000	30	30	4	2	3.4	2	1	1.1	2	0	0.9	2	0	0.4	1	0	0.1
7.	1000	30	30	5	0	3.4	2	0	1.0	2	0	1.3	1	0	0.2	1	0	0.1
						3.4			1.0			1.1			0.3			0.1

(1) Seconds after start of open rack acceleration.

(2) Constant Sampling

(3) Load is impressed at 30 mph and left in dynamometer throughout acceleration.

TABLE 4A. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 4, 1966

Type Operation: Idle-Acceleration And Constant Speed
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite Responses 0	1	2	3	4	5	6	7	8	Ave.
IDLE-ACCELERATION													
1. 0(1)	0-30	30(2)	200					2	3	6	3		5.7
15	0-30	30	200					1	3	8	2		5.8
30	0-30	30	200				1	1	4	8			5.4
45	0-30	30	200				1	4	8	1			4.6
60	0-30	30	200				2	5	7				4.4
2. 0	0-30	0	200						8	6			5.4
15	0-30	0	200					2	6	6			5.3
30	0-30	0	200				1	2	6	5			5.1
45	0-30	0	200				2	3	4	5			4.9
60	0-30	0	200				3	5	4	2			4.4
3. 0	0-30	30	800					6	5	3			4.8
15	0-30	30	800				2	4	7	1			4.5
30	0-30	30	800				2	6	6				4.3
45	0-30	30	800				3	8	3				4.0
60	0-30	30	800				5	6	3				3.9
4. 0	0-30	0	800				4	3	7				4.2
15	0-30	0	800				1	7	6				4.4
30	0-30	0	800				1	7	6				4.4
45	0-30	0	800				4	7	3				3.9
60	0-30	0	800		1		7	6					3.3
CONSTANT SPEED													
5.	30	30	1000			2	5	7					3.4
6.	30	30	1000		1	4	6	2					2.5
7.	30	30	1000	2			3	7	2				3.4
8.	30	0	1000	2	1	5	6						2.1
9.	30	0	100	1	1			1		4	7		5.6
10.	30	30	100					2	2	2	1	7	6.6

(1) - (2) See Table 4 for explanation.

TABLE 4B. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 4, 1966

Type Operation: Idle-Acceleration and Constant Speed
Fuel: Reference No. 1

Run	Speed	Load	Dilution	"B" Standard Responses				
No.	MPH	HP	Ratio	0	1	2	3	Ave.
IDLE-ACCELERATION								
1. 0(1)	0-30	30(2)	200		1	10	3	2.1
15	0-30	30	200		2	10	2	2.0
30	0-30	30	200		8	5	1	1.5
45	0-30	30	200		11	3		1.2
60	0-30	30	200		11	3		1.2
2. 0	0-30	0	200		6	6	2	1.7
15	0-30	0	200		8	5	1	1.5
30	0-30	0	200		7	7		1.5
45	0-30	0	200		8	6		1.4
60	0-30	0	200		11	3		1.2
3. 0	0-30	30	800		8	6		1.4
15	0-30	30	800		11	3		1.2
30	0-30	30	800		12	2		1.1
45	0-30	30	800		13	1		1.1
60	0-30	30	800		13	1		1.1
4. 0	0-30	0	800	2	7	5		1.2
15	0-30	0	800	1	9	4		1.2
30	0-30	0	800	1	11	2		1.1
45	0-30	0	800	3	10	1		0.9
60	0-30	0	800	6	8			0.6
CONSTANT SPEED								
5.	30	30	1000		13	1		1.1
6.	30	30	1000	1	13			0.9
7.	30	30	1000	4	6	4		1.0
8.	30	0	1000	7	7			0.5
9.	30	0	100		3	8	3	2.0
10.	30	30	100		4	4	6	2.1

(1) - (2) See Table 4 for explanation.

TABLE 4C. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 4, 1966

Type Operation: Idle-Acceleration and Constant Speed
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"O" Standard Responses				
				0	1	2	3	Ave.
IDLE-ACCELERATION								
1. 0(1)	0-30	30(2)	200		2	12		1.9
15	0-30	30	200	1	6	7		1.4
30	0-30	30	200	1	9	4		1.2
45	0-30	30	200	1	11	2		1.1
60	0-30	30	200	1	12	1		1.0
2. 0	0-30	0	200	2	6	6		1.3
15	0-30	0	200	2	9	3		1.1
30	0-30	0	200	1	8	5		1.3
45	0-30	0	200	2	6	6		1.3
60	0-30	0	200	1	8	4		1.1
3. 0	0-30	30	800	1	7	6		1.4
15	0-30	30	800	1	8	5		1.3
30	0-30	30	800	1	10	3		1.1
45	0-30	30	800	1	9	4		1.2
60	0-30	30	800	3	7	4		1.1
4. 0	0-30	0	800	1	8	5		1.3
15	0-30	0	800	1	11	2		1.1
30	0-30	0	800	1	6	7		1.4
45	0-30	0	800	3	6	5		1.1
60	0-30	0	800	3	9	2		0.9
CONSTANT SPEED								
5.	30	30	1000	2	11	1		0.9
6.	30	30	1000	3	11			0.8
7.	30	30	1000	3	4	7		1.3
8.	30	0	1000	5	7	2		0.8
9.	30	0	100		3	10	1	1.9
10.	30	30	100	1	3	7	3	1.9

(1) - (2) See Table 4 for explanation.

TABLE 4D. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 4, 1966

Type Operation: Idle-Acceleration and Constant Speed
Fuel: Reference No. 1

Run	Speed	Load	Dilution	"A" Standard Responses			
No.	MPH	HP	Ratio	0	1	2	Average
IDLE - ACCELERATION							
1. 0(1)	0-30	30(2)	200	4	7	3	0.9
15	0-30	30	200	3	9	2	0.9
30	0-30	30	200	2	10	2	1.0
45	0-30	30	200	5	9		0.6
60	0-30	30	200	4	10		0.7
2. 0	0-30	0	200	1	10	3	1.1
15	0-30	0	200	2	10	2	1.0
30	0-30	0	200	4	8	2	0.9
45	0-30	0	200	5	8	1	0.7
60	0-30	0	200	5	7	2	0.8
3. 0	0-30	30	800		10	4	0.3
15	0-30	30	800	10	4		0.3
30	0-30	30	800	11	3		0.2
45	0-30	30	800	11	3		0.2
60	0-30	30	800	12	2		0.1
4. 0	0-30	0	800	6	6	2	0.7
15	0-30	0	800	7	7		0.5
30	0-30	0	800	11	3		0.2
45	0-30	0	800	9	4	1	0.4
60	0-30	0	800	9	4	1	0.4
CONSTANT SPEED							
5.	30	30	1000	10	3	1	0.4
6.	30	30	1000	12	1	1	0.2
7.	30	30	1000	11	3		0.2
8.	30	0	1000	12	2		0.1
9.	30	0	100	5	3	6	1.1
10.	30	30	100	3	6	5	1.1

(1) - (2) See Table 4 for explanation.

TABLE 4E. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 4, 1966

Type Operation: Idle-Acceleration and Constant Speed
Fuel Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"P" Standard Responses 0	1	2	Average
IDLE-ACCELERATION							
1. 0(1)	0-30	30(2)	200	11	3		0.2
15	0-30	30	200	9	5		0.4
30	0-30	30	200	11	3		0.2
45	0-30	30	200	10	4		0.3
60	0-30	30	200	12	2		0.1
2. 0	0-30	0	200	7	6	1	0.6
15	0-30	0	200	11	2	1	0.3
30	0-30	0	200	13	1		0.1
45	0-30	0	200	13	1		0.1
60	0-30	0	200	13	1		0.1
3. 0	0-30	30	800	9	5		0.4
15	0-30	30	800	10	4		0.3
30	0-30	30	800	12	2		0.1
45	0-30	30	800	11	3		0.2
60	0-30	30	800	9	5		0.4
4. 0	0-30	0	800	12	2		0.1
15	0-30	0	800	12	2		0.1
30	0-30	0	800	10	4		0.3
45	0-30	0	800	13	1		0.1
60	0-30	0	800	13	1		0.1
CONSTANT SPEED							
5.	30	30	1000	13	1		0.1
6.	30	30	1000	13	1		0.1
7.	30	30	1000	12	2		0.1
8.	30	0	1000	14	0		0
9.	30	0	100	10	4		0.3
10.	30	30	100	9	5		0.4

(1) - (2) See Table 4 for explanation.

TABLE 5. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
2.	100	30	0	7	5	6.0	3	1	1.9	2	1	1.8	2	0	1.0	1	0	0.2
3.	100	30	0	7	3	5.0	2	1	1.5	2	1	1.5	1	0	0.7	1	0	0.1
13.	100	30	0	7	4	6.5	3	1	2.1	2	1	1.8	2	1	1.4	1	0	0.4
15.	100	30	0	8	6	6.6	3	1	2.1	2	1	1.6	2	0	1.2	1	0	0.5
16.	100	30	0	7	6	6.2	2	1	1.9	3	1	1.5	2	0	1.2	1	0	0.2
						6.1			1.9			1.6			1.1			0.3
14.	100	30	30	8	6	6.9	3	2	2.5	3	0	1.7	2	0	0.9	1	0	0.5
10.	500	30	0	5	2	3.5	2	0	1.0	2	0	0.7	2	0	0.6	1	0	0
11.	500	30	0	5	2	3.5	2	0	1.0	1	0	0.8	1	0	0.5	1	0	0.3
18.	500	30	0	4	1	2.2	1	0	0.7	2	0	0.8	1	0	0.2	0	0	0
						3.1			0.9			0.8			0.4			0.1
4.	500	30	30	6	2	4.0	1	0	0.9	1	0	0.6	1	0	0.2	0	0	0
9.	500	30	30	5	2	2.3	2	0	1.0	2	0	0.7	2	0	0.8	1	0	0.1
12.	500	30	30	6	3	4.3	2	1	1.2	2	1	1.0	2	0	0.8	1	0	0.1
17.	500	30	30	6	2	3.0	2	1	1.9	1	0	0.4	2	0	0.6	1	0	0.2
						3.4			1.3			0.7			0.6			0.1
5.	1000	30	0	4	1	2.5	1	0	0.9	1	0	0.5	1	0	0.3	0	0	0
6.	1000	30	0	4	2	2.9	1	0	0.9	1	0	0.6	2	0	0.7	0	0	0
8.	1000	30	0	5	2	3.3	2	0	1.0	2	0	0.7	1	0	0.5	0	0	0
						2.9			0.9			0.6			0.5			0
1.	1000	30	30	5	3	3.9	2	1	1.1	2	0	0.8	2	0	0.5	0	0	0
7.	1000	30	30	3	1	2.3	1	0	0.7	1	0	0.2	2	0	0.9	0	0	0
						3.1			0.9			0.5			0.7			0

(1) Constant Sampling

TABLE 5A. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 7, 1966

Type Operation: Constant Speed
Vehicle Speed: 30 mph
Fuel: Reference No. 1

Run	Load	Dilution	"D" Composite Responses									
No.	HP	Ratio	0	1	2	3	4	5	6	7	8	Ave.
1.	30	1000				4	7	2				3.9
2.	0	100						5	3	5		6.0
3.	0	100				1	3	5	3	1		5.0
4.	30	500			1	11			1			4.0
5.	0	1000		1	6	4	2					2.5
6.	0	1000			5	5	3					2.9
7.	30	1000		2	5	6						2.3
8.	0	1000			2	7	2	2				3.3
9.	30	500			3	7	2	1				2.3
10.	0	500			1	7	3	2				3.5
11.	0	500			1	6	5	1				3.5
12.	30	500				2	6	4	1			4.3
13.	0	100					1		4	8		6.5
14.	30	100							4	6	3	6.9
15.	0	100							8	4	1	6.6
16.	0	100							10	3		6.2
17.	30	500			3	6	1	2	1			3.0
18.	0	500	1	2	4	4	2					2.2

TABLE 5B. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS

(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 7, 1966

Type Operation: Constant Speed
Vehicle Speed: 30 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"B" Standard Responses 0	1	2	3	Average
1.	30	1000		11	2		1.9
2.	0	100		4	6	3	1.9
3.	0	100		6	7		1.5
4.	30	500	1	12			0.9
5.	0	1000	1	12			0.9
6.	0	1000	2	11			0.9
7.	30	1000	4	9			0.7
8.	0	1000	1	11	1		1.0
9.	30	500	2	9	2		1.0
10.	0	500	1	11	1		1.0
11.	0	500	1	11	1		1.0
12.	30	500		10	3		1.2
13.	0	100		2	8	3	2.9
14.	30	100			7	6	2.5
15.	0	100		1	10	2	2.9
16.	0	100		2	11		1.9
17.	30	500		12	1		1.9
18.	0	500	4	9			0.7

TABLE 5C. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS

(Oily "O" Standard)

Run No.	Load HP	Dilution Ratio	"O" Standard Responses 0	1	2	3	Average
1.	30	1000	3	8	2		0.8
2.	0	100		3	10		1.8
3.	0	100		7	6		1.5
4.	30	500	5	8			0.6
5.	0	1000	6	7			0.5
6.	0	1000	7	6			0.6
7.	30	1000	11	2			0.2
8.	0	1000	5	7	1		0.7
9.	30	500	5	7	1		0.7
10.	0	500	5	7	1		0.7
11.	0	500	3	10			0.8
12.	30	500	1	11	1		1.0
13.	0	100		3	10		1.8
14.	30	100	1	3	8	1	1.7
15.	0	100		5	8		1.6
16.	0	100	1	6	4	2	1.5
17.	30	500	8	5			0.4
18.	0	500	6	4	3		0.8

TABLE 5D. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 7, 1966

Type of Operation: Constant Speed
Vehicle Speed: 30 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"A" Standard Responses 0	1	2	Average
1.	30	1000	8	4	1	0.5
2.	0	100	2	9	2	1.0
3.	0	100	4	9		0.7
4.	30	500	10	3		0.2
5.	0	1000	9	4		0.3
6.	0	1000	5	7	1	0.7
7.	30	1000	3	8	2	0.9
8.	0	1000	6	7		0.5
9.	30	500	4	8	1	0.8
10.	0	500	6	6	1	0.6
11.	0	500	6	7		0.5
12.	30	500	5	6	2	0.8
13.	0	100		8	5	1.4
14.	30	100	2	9	2	0.9
15.	0	100	2	7	4	1.2
16.	0	100	2	7	4	1.2
17.	30	500	6	6	1	0.6
18.	0	500	11	2		0.2

TABLE 5E. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Run No.	Load HP	Dilution Ratio	"P" Standard Responses 0	1	Average
1.	30	1000	13		0
2.	0	100	10	3	0.2
3.	0	100	12	1	0.1
4.	30	500	13		0
5.	0	1000	13		0
6.	0	1000	13		0
7.	30	1000	13		0
8.	0	1000	13		0
9.	30	500	12	1	0.1
10.	0	500	13		0
11.	0	500	9	4	0.3
12.	30	500	12	1	0.1
13.	0	100	8	5	0.4
14.	30	100	6	7	0.5
15.	0	100	7	6	0.5
16.	0	100	10	3	0.2
17.	30	500	11	2	0.2
18.	0	500	13		0

TABLE 6. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Idle-Acceleration)

Run No.	Dilution Ratio(5)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
4. a. (1)	100	0-35	0	7	5	6. 2	3	1	2. 2	3	1	1. 8	2	0	1. 0	1	0	0. 5
5. a.	100	0-35	0	7	6	6. 5	3	1	2. 1	2	1	1. 5	2	0	1. 2	1	0	0. 7
15. a.	100	0-35	0	7	5	6. 5	3	1	2. 2	3	0	1. 7	2	1	1. 2	1	0	0. 5
						6. 4			2. 2			1. 8			1. 2			0. 6
4. b. (2)	100	0-35	0	7	6	6. 3	3	1	2. 2	3	1	1. 8	2	0	1. 1	1	0	0. 6
5. b.	100	0-35	0	7	6	6. 2	3	1	1. 9	3	0	1. 5	2	0	1. 0	1	0	0. 6
15. b.	100	0-35	0	7	5	6. 5	3	1	2. 3	3	1	1. 5	2	1	1. 3	1	0	0. 6
						6. 3			2. 1			1. 3			1. 1			0. 6
4. c. (3)	100	0-35	0	6	5	5. 9	3	1	2. 1	3	1	1. 5	2	0	1. 1	1	0	0. 6
5. c.	100	0-35	0	7	5	6. 3	3	1	2. 3	3	1	1. 5	2	0	1. 0	1	0	0. 7
15. c.	100	0-35	0	7	6	6. 5	3	1	2. 2	3	1	1. 4	2	0	1. 2	1	0	0. 9
						6. 2			2. 2			1. 5			1. 1			0. 7
6. a.	100	0-35	30(4)	8	6	6. 6	3	1	2. 2	3	0	1. 6	2	0	0. 8	2	0	0. 9
10. a.	100	0-35	30	7	5	6. 0	3	1	2. 2	2	1	1. 8	2	0	0. 9	1	0	0. 5
						6. 3			2. 2			1. 7			0. 8			0. 7
6. b.	100	0-35	30	7	6	6. 2	3	1	2. 0	3	0	1. 4	2	0	0. 9	2	0	0. 9
10. b.	100	0-35	30	6	5	5. 9	3	2	2. 1	3	1	1. 6	1	0	0. 9	1	0	0. 5
						6. 0			1. 0			1. 5			0. 9			0. 7
6. c.	100	0-35	30	7	5	7. 1	3	1	1. 7	2	1	1. 3	2	0	1. 0	2	0	1. 1
10. c.	100	0-35	30	7	5	6. 3	3	2	2. 2	2	1	1. 4	2	0	1. 2	1	0	0. 6
						6. 7			1. 9			1. 4			1. 1			0. 9
8. a.	500	0-35	0	4	3	3. 3	1	1	1. 0	1	0	0. 7	1	0	0. 5	1	0	0. 2
13. a.	500	0-35	0	5	2	3. 2	2	1	1. 1	1	0	0. 8	2	0	0. 5	1	0	0. 2
						3. 3			1. 0			0. 7			0. 5			0. 2
8. b.	500	0-35	0	4	2	2. 6	1	0	0. 9	1	0	0. 8	1	0	0. 5	1	0	0. 2
13. b.	500	0-35	0	4	2	3. 2	1	1	1. 0	2	0	0. 9	2	0	0. 4	1	0	0. 3
						2. 9			1. 0			0. 9			0. 4			0. 3
8. c.	500	0-35	0	4	2	2. 6	1	0	0. 8	1	0	0. 6	1	0	0. 4	1	0	0. 4
13. c.	500	0-35	0	3	2	2. 8	1	1	1. 0	1	0	0. 8	1	0	0. 2	1	0	0. 3
						2. 7			0. 9			0. 7			0. 3			0. 4

TABLE 6. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Bus 695 - Idle-Acceleration)

Run No.	Dilution Ratio(5)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
7. a.	500	0-35	30	4	3	3.4	1	1	1.0	1	0	0.9	1	0	0.7	1	0	0.1
9. a.	500	0-35	30	5	2	3.3	2	1	1.1	1	0	0.8	1	0	0.7	1	0	0.2
12. a.	500	0-35	30	5	3	3.9	2	1	1.3	2	0	0.9	2	0	0.8	1	0	0.5
						3.5			1.1			0.6			0.7			0.3
7. b.	500	0-35	30	4	3	3.8	1	1	1.0	1	0	0.8	1	0	0.7	1	0	0.2
9. b.	500	0-35	30	4	3	3.5	2	1	1.1	2	0	0.9	1	0	0.3	1	0	0.3
12. b.	500	0-35	30	5	2	3.9	2	1	1.2	2	0	0.9	2	0	0.6	1	0	0.6
						3.4			1.1			0.9			0.5			0.4
7. c.	500	0-35	30	4	2	3.0	1	1	1.0	2	0	0.5	2	0	0.8	1	0	0.2
9. c.	500	0-35	30	5	2	3.4	1	0	0.9	1	0	0.7	2	0	0.6	1	0	0.4
12. c.	500	0-35	30	5	2	3.2	1	1	1.0	2	0	0.9	2	0	0.6	1	0	0.4
						3.2			1.0			0.7			0.7			0.3
1. a.	1000	0-35	0	5	3	4.2	2	1	1.2	1	0	0.7	2	0	0.8	1	0	0.2
11. a.	1000	0-35	0	7	3	5.3	3	1	1.8	2	0	1.0	2	0	1.1	2	0	0.6
						4.7			1.5			0.9			1.0			0.4
1. b.	1000	0-35	0	6	2	4.2	2	1	1.4	1	0	0.8	2	0	0.9	1	0	0.3
11. b.	1000	0-35	0	6	3	4.8	3	1	1.7	2	0	1.0	2	0	0.8	1	0	0.2
						4.5			1.5			0.9			0.9			0.3
1. c.	1000	0-35	0	5	1	3.3	1	1	1.0	1	0	0.7	2	0	0.5	1	0	0.4
11. c.	1000	0-35	0	5	2	4.2	2	1	1.5	2	0	0.9	2	0	0.9	1	0	0.4
						3.7			1.2			0.8			0.7			0.4
2. a.	1000	0-35	30	6	3	4.2	2	1	1.5	1	0	0.8	2	0	0.7	1	0	0.4
3. a.	1000	0-35	30	6	3	4.5	2	1	1.5	2	0	0.9	1	0	0.7	2	0	0.6
14. a.	1000	0-35	30	4	3	3.5	1	1	1.0	2	0	0.9	1	0	0.5	1	0	0.4
						4.1			1.4			0.9			0.6			0.5
2. b.	1000	0-35	30	5	3	4.3	2	1	1.4	2	0	0.6	2	0	0.7	1	0	0.4
3. b.	1000	0-35	30	5	3	4.3	2	1	1.4	1	0	0.8	1	0	0.8	1	0	0.5
14. b.	1000	0-35	30	4	3	3.2	1	0	0.9	1	0	0.8	1	0	0.8	1	0	0.4
						3.9			1.2			0.8			0.7			0.4
2. c.	1000	0-35	30	5	3	4.9	2	1	1.2	1	0	0.5	2	0	1.0	1	0	0.5
3. c.	1000	0-35	30	4	2	3.5	2	1	2.2	1	0	0.7	1	0	0.6	1	0	0.5
14. c.	1000	0-35	30	4	3	3.2	1	0	0.9	1	0	0.7	1	0	0.6	1	0	0.3
						3.6			1.4			0.6			0.7			0.4

(1) "a" exposure is 3 seconds after start of open rack acceleration

(2) "b" exposure is 5 seconds after upshift

(3) "c" exposure is on reaching 35 mph

(4) Load is impressed at 30 mph and left in dynamometer throughout acceleration

(5) Constant Sampling

TABLE 6A. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 8, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"D" Composite Responses 1	2	3	4	5	6	7	8	Ave.
1. a. (1)	0	1000			3	5	5				4.2
b. (2)	0	1000		1	2	6	1	3			4.2
c. (3)	0	1000	1		7	3	2				3.3
2. a.	30(4)	1000			4	3	5	1			4.2
b.	30	1000			1	7	6				4.3
c.	30	1000			4	4	5				4.1
3. a.	30	1000			2	5	4	2			4.5
b.	30	1000			3	3	7				4.3
c.	30	1000		1	4	8					3.5
4. a.	0	100					1	8	4		6.2
b.	0	100						9	4		6.3
c.	0	100					2	11			5.9
5. a.	0	100						6	7		6.5
b.	0	100						11	2		6.2
c.	0	100					1	7	5		6.3
6. a.	30	100						6	6	1	6.6
b.	30	100						11	2		6.2
c.	30	100					2	9	2		7.1
7. a.	30	500			8	5					3.4
b.	30	500			3	10					3.8
c.	30	500		2	9	2					3.0
8. a.	0	500			9	4					3.3
b.	0	500		3	7	3					2.6
c.	0	500		5	7	1					2.6
9. a.	30	500		2	6	4	1				3.3
b.	30	500			6	7					3.5
c.	30	500		1	7	4	1				3.4
10. a.	30	100					2	9	2		6.0
b.	30	100					2	11			5.9
c.	30	100					1	7	5		6.3
11. a.	0	1000			3		3	4	3		5.3
b.	0	1000			3		7	3			4.8
c.	0	1000		1	1	6	5				4.2
12. a.	30	500			4	3	6				3.9
b.	30	500		2	2	5	4				3.9
c.	30	500		3	5	4	1				3.2
13. a.	0	500		4	3	5	1				3.2
b.	0	500		1	9	3					3.2
c.	0	500		3	10						2.8
14. a.	30	1000			6	7					3.5
b.	30	1000			10	3					3.2
c.	30	1000			10	3					3.2
15. a.	0	100					1	5	7		6.5
b.	0	100					1	5	7		6.5
c.	0	100						7	6		6.5

(1) - (4) See Table 6 for explanation.

TABLE 6B. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695	Type Operation: Idle-Acceleration
Sample Method: Constant	Vehicle Speed: 0-35 mph
Date: November 8, 1966	Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"B" Standard Responses 0	1	2	3	Average
1. a. (1)	0	1000		10	3		1.2
b. (2)	0	1000		8	5		1.4
c. (3)	0	1000		13			1.0
2. a.	30(4)	1000		6	7		1.5
b.	30	1000		8	5		1.4
c.	30	1000		10	3		1.2
3. a.	30	1000		6	7		1.5
b.	30	1000		8	5		1.4
c.	30	1000		10	3		2.2
4. a.	0	100		1	9	3	2.2
b.	0	100		1	9	3	2.2
c.	0	100		2	8	3	2.1
5. a.	0	100		1	10	2	2.1
b.	0	100		3	9	1	1.9
c.	0	100		4	7	2	2.3
6. a.	30	100		2	7	4	2.2
b.	30	100		3	7	3	2.0
c.	30	100		3	8	1	1.7
7. a.	30	500		13			1.0
b.	30	500		13			1.0
c.	30	500		13			1.0
8. a.	0	500		13			1.0
b.	0	500	1	12			0.9
c.	0	500	2	11			0.8
9. a.	30	500		12	1		1.1
b.	30	500		12	1		1.1
c.	30	500	1	12			0.9
10. a.	30	100		2	7	4	2.2
b.	30	100			12	1	2.1
c.	30	100			11	2	2.2
11. a.	0	1000		4	8	1	1.8
b.	0	1000		5	7	1	1.7
c.	0	1000		7	6		1.5
12. a.	30	500		9	4		1.3
b.	30	500		10	3		1.2
c.	30	500		13			1.0
13. a.	0	500		12	1		1.1
b.	0	500		13			1.0
c.	0	500		13			1.0
14. a.	30	1000		13			1.0
b.	30	1000	1	12			0.9
c.	30	1000	1	12			0.9
15. a.	0	100		1	8	4	2.2
b.	0	100		1	7	5	2.3
c.	0	100		1	9	3	2.2

(1) - (4) See Table 6 for explanation.

TABLE 6C. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695	Type Operation: Idle-Acceleration
Sample Method: Constant	Vehicle Speed: 0-35 mph
Date: November 8, 1966	Fuel: Reference No. 1

Run	Load	Dilution	"O" Standard Responses				
No.	HP	Ratio	0	1	2	3	Average
1. a. (1)	0	1000	4	9			0.7
b. (2)	0	1000	3	10			0.8
c. (3)	0	1000	4	9			0.7
2. a.	30(4)	1000	3	10			0.8
b.	30	1000	4	7	2		0.9
c.	30	1000	6	7			0.5
3. a.	30	1000	2	10	1		0.9
b.	30	1000	3	10			0.8
c.	30	1000	4	9			0.7
4. a.	0	100		4	8	1	1.8
b.	0	100		6	4	3	1.8
c.	0	100		8	3	2	1.5
5. a.	0	100		6	7		1.5
b.	0	100	1	6	5	1	1.5
c.	0	100		7	5	1	1.5
6. a.	30	100	1	5	5	2	1.6
b.	30	100	1	7	4	1	1.4
c.	30	100		9	4		1.3
7. a.	30	500	2	11			0.9
b.	30	500	3	10			0.8
c.	30	500	7	5	1		0.5
8. a.	0	500	4	9			0.7
b.	0	500	3	10			0.8
c.	0	500	5	8			0.6
9. a.	30	500	3	10			0.8
b.	30	500	2	10	1		0.9
c.	30	500	4	9			0.7
10. a.	30	100		3	10		1.8
b.	30	100		6	7	1	1.6
c.	30	100		8	5		1.4
11. a.	0	1000	2	9	2		1.0
b.	0	1000	2	9	2		1.0
c.	0	1000	3	8	2		0.9
12. a.	30	500	3	9	1		0.9
b.	30	500	3	8	2		0.9
c.	30	500	2	10	1		0.9
13. a.	0	500	3	10			0.8
b.	0	500	2	10	1		0.9
c.	0	500	3	10			0.8
14. a.	30	1000	3	9	1		0.9
b.	30	1000	3	10			0.8
c.	30	1000	4	9			0.7
15. a.	0	100	1	4	6	2	1.7
b.	0	100		5	7	1	1.5
c.	0	100		6	6	1	1.4

(1) - (4) See Table 6 for explanation.

TABLE 6D. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 8, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"A" Standard Responses			
			0	1	2	Average
1. a. (1)	0	1000	5	5	3	0.8
b. (2)	0	1000	3	8	2	0.9
c. (3)	0	1000	8	4	1	0.5
2. a.	30(4)	1000	6	5	2	0.7
b.	30	1000	5	7	1	0.7
c.	30	1000	2	9	2	1.0
3. a.	30	1000	4	9		0.7
b.	30	1000	3	10		0.8
c.	30	1000	5	8		0.6
4. a.	0	100	3	7	3	1.0
b.	0	100	2	8	3	1.1
c.	0	100	2	8	3	1.1
5. a.	0	100	1	8	4	1.2
b.	0	100	3	7	3	1.0
c.	0	100	4	5	4	1.0
6. a.	30	100	5	6	2	0.8
b.	30	100	3	8	2	0.9
c.	30	100	2	9	2	1.0
7. a.	30	500	4	9		0.7
b.	30	500	4	9		0.7
c.	30	500	3	9	1	0.8
8. a.	0	500	7	6		0.5
b.	0	500	7	6		0.5
c.	0	500	8	5		0.4
9. a.	30	500	4	9		0.7
b.	30	500	9	4		0.3
c.	30	500	6	6	1	0.6
10. a.	30	100	3	9	1	0.9
b.	30	100	1	12		0.9
c.	30	100	1	8	4	1.2
11. a.	0	1000	2	8	3	1.8
b.	0	1000	4	8	1	0.8
c.	0	1000	2	10	1	0.9
12. a.	30	500	5	6	2	0.8
b.	30	500	6	6	1	0.6
c.	30	500	6	6	1	0.6
13. a.	0	500	9	3	1	0.5
b.	0	500	9	3	1	0.4
c.	0	500	10	3		0.2
14. a.	30	1000	6	7		0.5
b.	30	1000	4	8	1	0.8
c.	30	1000	6	6	1	0.6
15. a.	0	100		10	3	1.2
b.	0	100		9	4	1.3
c.	0	100	1	9	3	1.2

(1) - (4) See Table 6 for explanation.

TABLE 6E. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 8, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"P" Standard Responses			
			0	1	2	Average
1. a. (1)	0	1000	11	2		0.2
b. (2)	0	1000	9	4		0.3
c. (3)	0	1000	8	5		0.4
2. a.	30(4)	1000	8	5		0.4
b.	30	1000	8	5		0.4
c.	30	1000	6	7		0.5
3. a.	30	1000	6	6	1	0.6
b.	30	1000	6	7		0.5
c.	30	1000	7	6		0.5
4. a.	0	100	6	7		0.5
b.	0	100	5	8		0.6
c.	0	100	5	8		0.6
5. a.	0	100	4	9		0.7
b.	0	100	5	8		0.6
c.	0	100	4	9		0.7
6. a.	30	100	3	9		0.9
b.	30	100	3	9		0.9
c.	30	100	2	8		1.1
7. a.	30	500	12	1		0.1
b.	30	500	10	3		0.2
c.	30	500	11	2		0.2
8. a.	0	500	11	2		0.2
b.	0	500	10	3		0.2
c.	0	500	8	5		0.4
9. a.	30	500	11	2		0.2
b.	30	500	9	4		0.3
c.	30	500	8	5		0.4
10. a.	30	100	7	6		0.5
b.	30	100	6	7		0.5
c.	30	100	5	8		0.6
11 a.	0	1000	6	6	1	0.6
b.	0	1000	10	3		0.2
c.	0	1000	8	5		0.4
12. a.	30	500	6	7		0.5
b.	30	500	5	8		0.6
c.	30	500	8	5		0.4
13. a.	0	500	10	3		0.2
b.	0	500	9	4		0.3
c.	0	500	9	4		0.3
14. a.	30	1000	8	5		0.4
b.	30	1000	8	5		0.4
c.	30	1000	9	4		0.3
15. a.	0	100	6	7		0.5
b.	0	100	5	8		0.6
c.	0	100	2	11		0.9

(1) - (4) See Table 6 for explanation.

TABLE 7. SERIES II PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
4.	100	20	0	7	5	5.8	3	1	1.8	3	1	1.7	2	0	1.0	1	0	0.6
5.	100	20	0	6	4	5.3	3	1	1.7	2	1	0.5	2	0	0.9	1	0	0.6
9.	100	20	0	7	5	5.9	3	1	2.7	2	0	1.4	2	0	0.8	1	0	0.4
10.	100	20	0	6	4	4.8	3	0	1.5	2	1	1.4	2	0	0.9	1	0	0.5
16.	100	20	0	6	3	5.2	2	1	1.7	3	0	1.7	1	0	0.7	1	0	0.8
20.	100	20	0	6	4	5.2	2	0	1.4	3	0	1.4	2	0	0.8	1	0	0.5
25.	100	20	0	6	6	6.0	3	1	2.0	2	1	1.5	2	0	1.0	1	0	0.7
						5.4			1.8			1.3			0.9			0.6
15.	100	20	40	7	3	6.8	3	1	2.0	3	0	1.9	2	0	1.0	1	0	0.4
19.	100	20	40	7	3	5.1	3	1	1.7	2	0	1.3	2	1	1.3	1	0	0.6
26.	100	20	40	7	6	6.8	3	1	1.5	2	1	1.5	2	0	1.3	1	0	0.8
						6.2			1.7			1.6			1.2			0.6
7.	300	20	0	5	3	4.2	2	1	1.0	1	0	0.9	1	0	0.8	1	0	0.5
18.	300	20	0	4	2	3.5	2	0	1.4	2	0	0.9	1	0	0.5	1	0	0.2
22.	300	20	0	4	2	3.3	2	0	1.1	2	0	1.0	1	0	0.9	1	0	0.3
						3.7			1.1			0.9			0.7			0.3
3.	300	20	40	5	3	4.3	2	0	1.0	2	0	0.9	1	0	0.7	1	0	0.1
6.	300	20	40	6	4	5.7	2	1	1.3	2	0	0.9	1	0	0.8	1	0	0.6
11.	300	20	40	6	4	5.0	3	0	1.4	2	0	1.1	3	0	1.3	1	0	0.5
12.	300	20	40	6	4	4.6	3	0	1.0	2	0	1.0	3	1	1.5	1	0	0.5
13.	300	20	40	5	4	4.6	2	1	1.2	2	0	0.9	3	0	1.2	1	0	0.2
23.	300	20	40	6	3	5.0	3	1	1.8	2	0	1.1	2	0	1.7	1	0	0.7
						4.9			1.3			1.0			1.2			0.4
2.	1000	20	0	5	2	4.0	2	1	1.0	1	0	0.5	1	0	0.7	1	0	0
14.	1000	20	0	4	2	3.3	3	0	1.2	1	0	0.5	2	0	0.6	1	0	0.1
						3.7			1.1			0.5			0.7			0.0
1.	1000	20	40	4	3	3.4	2	1	1.0	2	0	0.9	1	0	0.7	1	0	0.1
8.	1000	20	40	4	2	3.2	2	0	1.0	1	0	0.7	1	0	0.4	1	0	0.2
17.	1000	20	40	4	3	3.9	2	1	0.3	2	0	0.9	2	0	0.7	1	0	0.3
21.	1000	20	40	6	2	3.5	2	0	0.9	2	0	0.9	2	0	0.8	1	0	0.2
24.	1000	20	40	5	3	4.0	1	1	1.0	1	0	0.9	1	0	0.4	1	0	0.2
						3.6			0.8			0.8			0.6			0.3

(1) Constant Sample

TABLE 7A. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 9, 1966

Type Operation: Constant Speed
Vehicle Speed: 20 mph
Fuel: Reference No. 1

Run	Load	Dilution	"D" Composite Responses						
No.	HP	Ratio	2	3	4	5	6	7	Ave.
1.	40	1000		7	5				3.4
2.	0	1000	2	4	4	2			4.0
3.	40	300		3	3	6			4.3
4.	0	100				5	5	2	5.8
5.	0	100			4	1	7		5.3
6.	40	300			4	6	2		5.7
7.	0	300		3	4	6			4.2
8.	40	1000	3	5	5				3.2
9.	0	100				3	9	1	5.9
10.	0	100			5	6	2		4.8
11.	40	300			3	8	2		4.9
12.	40	300			6	7	1		4.6
13.	40	300			5	8			4.6
14.	0	1000	1	8	4				3.3
15.	40	100		1			8	4	6.8
16.	0	100		1	1	5	6		5.2
17.	40	1000		2	11				3.9
18.	0	300	1	5	7				3.5
19.	40	100		1	1	3	6	2	5.1
20.	0	100			2	7	4		5.2
21.	40	1000	2	5	5	1			3.5
22.	0	300	1	7	5				3.3
23.	40	300		2	4	5	2		5.0
24.	40	1000		2	10	1			3.9
25.	0	100					13		6.0
26.	40	100					3	10	6.8

TABLE 7B. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 9, 1966

Type Operation: Constant Speed
Vehicle Speed: 20 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"B" Standard Responses 0	1	2	3	Average
1.	40	1000		11	1		1. 0
2.	0	1000		11	1		1. 0
3.	40	300	1	9	2		1. 0
4.	0	100		4	7	1	1. 8
5.	0	100		5	6	1	1. 7
6.	40	300		9	3		1. 3
7.	0	300		11	1		1. 0
8.	40	1000	1	11	1		1. 0
9.	0	100		4	8	1	2. 7
10.	0	100	2	3	7	1	1. 5
11.	40	300	1	7	4	1	1. 4
12.	40	300	1	11		1	1. 0
13.	40	300		10	3		1. 2
14.	0	1000	1	9	2	1	1. 2
15.	40	100		2	9	2	2. 0
16.	0	100		5	8		1. 7
17.	40	1000		9	4		1. 3
18.	0	300	1	10	2		1. 4
19.	40	100		6	5	2	1. 7
20.	0	100	1	7	5		1. 4
21.	40	1000	4	7	2		0. 9
22.	0	300	1	10	2		1. 1
23.	40	300		6	7	1	1. 8
24.	40	1000		13			1. 0
25.	0	100		1	11	1	2. 0
26.	40	100		1	8	4	1. 5

TABLE 7C. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 9, 1966

Type Operation: Constant Speed
Vehicle Speed: 20 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"O" Standard Responses 0	1	2	3	Average
1.	40	1000	5	5	2		0.9
2.	0	1000	6	6			0.5
3.	40	300	2	9	1		0.9
4.	0	100		5	6	1	1.7
5.	0	100		6	6		0.5
6.	40	300	3	7	2		0.9
7.	0	300	3	9			0.9
8.	40	1000	4	9			0.7
9.	0	100	1	6	6		1.4
10.	0	100		8	5		1.4
11.	40	300	1	10	2		1.1
12.	40	300	1	11	1		1.0
13.	40	300	3	9	1		0.9
14.	0	1000	6	7			0.5
15.	40	100	1	2	9	1	1.9
16.	0	100	1	3	8	1	1.7
17.	40	1000	5	4	4		0.9
18.	0	300	4	7	2		0.9
19.	40	100	2	5	6		1.3
20.	0	100	2	5	5	1	1.4
21.	40	1000	3	9	1		0.9
22.	0	300	2	9	2		1.0
23.	40	300	2	8	3		1.1
24.	40	1000	2	11			0.9
25.	0	100		6	7		1.5
26.	40	100		3	10		1.5

TABLE 7D. SERIES III PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: 20 mph
Date: November 9, 1966	Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"A" Standard Responses				
			0	1	2	3	Average
1.	40	1000	4	8			0.7
2.	0	1000	5	7			0.7
3.	40	300	4	8			0.7
4.	0	100	4	4	4		1.0
5.	0	100	3	7	2		0.9
6.	40	300	3	9			0.8
7.	0	300	3	10			0.8
8.	40	1000	8	5			0.4
9.	0	100	4	8	1		0.8
10.	0	100	2	10	1		0.9
11.	40	300	3	4	5	1	1.3
12.	40	300		7	5	1	1.5
13.	40	300	1	9	2	1	1.2
14.	0	1000	6	6	1		0.6
15.	40	100	1	11	1		1.0
16.	0	100	4	9			0.7
17.	40	1000	6	5	2		0.7
18.	0	300	6	7			0.5
19.	40	100		9	4		1.3
20.	0	100	4	8	1		0.8
21.	40	1000	3	9	1		0.9
22.	0	300	2	9	2		0.9
23.	40	300	2	8	3		0.7
24.	40	1000	2	11			0.4
25.	0	100		6	7		1.0
26.	40	100		3	10		1.3

TABLE 7E. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: 20 mph
Date: November 9, 1966	Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"P" Standard Responses 0	1	Average
1.	40	1000	11	1	0.1
2.	0	1000	12		0.0
3.	40	300	11	1	0.1
4.	0	100	5	7	0.6
5.	0	100	5	7	0.6
6.	40	300	5	7	0.6
7.	0	300	7	6	0.5
8.	40	1000	11	2	0.2
9.	0	100	8	5	0.4
10.	0	100	7	6	0.5
11.	40	300	7	6	0.5
12.	40	300	7	6	0.5
13.	40	300	11	2	0.2
14.	0	1000	12	1	0.1
15.	40	100	8	5	0.4
16.	0	100	3	10	0.8
17.	40	1000	9	4	0.3
18.	0	300	11	2	0.2
19.	40	100	5	8	0.6
20.	0	100	7	6	0.5
21.	40	1000	11	2	0.2
22.	0	300	9	4	0.3
23.	40	300	4	9	0.7
24.	40	1000	11	2	0.2
25.	0	100	4	9	0.7
26.	40	100	3	10	0.8

TABLE 8. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Constant Speed-Deceleration)

Run No.	Dilution Ratio(5)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
4. a. (1)	100	40	40(4)	7	6	6.6	3	1	1.3	2	0	1.1	2	0	0.6	2	1	1.2
5. a.	100	40	40	7	5	6.4	3	1	1.8	2	0	1.4	2	0	0.7	2	0	1.0
						6.5			1.8			1.3			0.7			1.1
4. b. (2)	100	40	40	7	6	6.6	3	1	1.9	2	0	1.3	2	0	0.6	2	1	1.3
5. b.	100	40	40	7	5	6.8	3	1	1.8	2	0	1.4	2	0	0.9	2	0	0.9
						6.6			1.9			1.3			0.7			1.1
4. c. (3)	100	40	40	7	5	6.4	3	1	2.0	2	0	1.1	2	0	0.8	2	1	1.3
5. c.	100	40	40	7	6	6.6	3	1	2.2	3	0	1.0	2	0	1.0	2	0	0.9
						6.5			2.1			1.0			0.9			1.1
3. a.	300	40	0	7	2	4.2	3	0	1.2	2	0	0.8	2	0	0.7	1	0	0.8
6. a.	300	40	0	5	3	4.4	2	0	1.1	1	0	0.8	2	0	1.1	1	0	1.2
10. a.	300	40	0	6	4	4.4	2	1	2.2	2	0	0.8	1	0	0.6	2	0	0.5
						4.3			1.5			0.8			0.9			0.8
3. b.	300	40	0	5	3	5.3	2	0	1.0	1	0	0.6	2	0	0.7	1	0	0.7
6. b.	300	40	0	5	3	4.1	2	0	1.1	1	0	0.8	2	0	0.9	1	0	0.4
10. b.	300	40	0	5	4	6.2	2	1	2.2	2	0	0.9	2	0	0.6	1	0	0.4
						5.2			1.4			0.8			0.8			0.4
3. c.	300	40	0	6	3	4.7	2	1	1.1	2	0	0.9	2	0	0.7	1	0	0.9
6. c.	300	40	0	6	3	4.6	2	1	1.2	1	0	0.8	2	0	0.9	1	0	0.4
10. c.	300	40	0	6	3	4.8	2	1	2.2	2	0	0.7	2	0	0.7	1	0	0.7
						4.7			1.5			0.8			0.8			0.7
11. a.	300	40	40	6	3	4.4	2	0	1.3									
11. b.	300	40	40	5	4	4.6	2	1	1.1					TIRE TROUBLE				
11. c.	300	40	40	6	4	4.9	2	1	1.2									
1. a.	1000	40	0	5	2	2.7	1	0	0.4	1	0	0.7	2	0	0.6	1	0	0.2
7. a.	1000	40	0	4	2	3.7	1	0	0.7	1	0	0.7	2	0	0.9	0	0	0
						3.2			0.8			0.7			0.7			0.1

TABLE 8. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Bus 695 - Constant Speed-Deceleration)

Run	Dilution	Speed	Load	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
No.	Ratio(5)	MPH	HP	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
1. b.	1000	40	0	5	3	3.4	1	0	0.9	2	0	0.8	2	0	0.4	1	0	0.4
7. b.	1000	40	0	4	2	3.4	1	0	0.7	2	0	0.9	2	0	0.9	0	0	0
						3.4			0.8			0.9			0.7			0.2
1. c.	1000	40	0	5	3	3.9	1	0	0.9	1	0	0.6	2	0	0.4	2	0	0.8
7. c.	1000	40	0	4	1	3.2	1	0	0.6	2	0	0.8	1	0	0.8	0	0	0
						3.6			0.8			0.7			0.8			0.4
2. a.	1000	40	40	5	2	3.1	1	0	0.9	1	0	0.6	2	0	0.5	1	0	0.4
8. a.	1000	40	40	5	2	2.9	1	0	0.6	1	0	0.8	2	0	1.0	1	0	0.1
9. a.	1000	40	40	4	2	3.4	2	0	0.9	2	0	0.6	1	0	0.6	1	0	0.1
						3.1			0.6			0.7			0.4			0.2
2. b.	1000	40	40	4	3	3.3	1	0	0.9	1	0	0.6	2	0	0.6	1	0	0.6
8. b.	1000	40	40	5	2	2.4	1	0	0.6	2	0	0.9	2	0	0.9	0	0	0
9. b.	1000	40	40	4	2	3.4	1	0	0.9	2	0	0.7	1	0	0.7	1	0	0.1
						3.0			0.8			0.6			0.7			0.2
2. c.	1000	40	40	4	3	3.6	1	0	0.9	1	0	0.7	2	0	0.5	2	0	0.9
8. c.	1000	40	40	4	3	3.4	1	0	0.9	2	0	0.8	2	0	0.7	1	0	0.4
9. c.	1000	40	40	4	3	3.3	1	1	1.0	1	0	0.7	2	0	0.6	1	0	0.5
						3.5			0.9			0.7			0.6			0.6

(1) "a" exposure is 5 seconds after closed rack deceleration following one minute at high speed and load

(2) "b" exposure is 25 seconds after closed rack deceleration following one minute at high speed and load

(3) "c" exposure is on downshift after closed rack deceleration following one minute at high speed and load

(4) Load at 40 mph for 1 minute, left in dynamometer during deceleration

(5) Constant Sampling

TABLE 8A. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 10, 1966

Type Operation: Constant Speed-Deceleration
Vehicle Speed: 40-0 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"D" Composite Responses							
			1	2	3	4	5	6	7	Average
1. a. (1)	0	1000		4	6	2	2			2.7
b. (2)	0	1000			9	4	1			3.4
c. (3)	0	1000			4	7	3			3.9
2. a.	40(4)	1000		3	8	1	2			3.1
b.	40	1000			10	4				3.3
c.	40	1000			5	9				3.6
3. a.	0	300		1	2	7	2	1	1	4.2
b.	0	300			1	4	9			5.3
c.	0	300			1	5	5	3		4.7
4. a.	40	100						6	8	6.6
b.	40	100						5	9	6.6
c.	40	100					1	6	7	6.4
5. a.	40	100					3	2	9	6.4
b.	40	100					1	4	9	6.6
c.	40	100						5	9	6.6
6. a.	0	300			2	5	7			4.7
b.	0	300			3	6	5			4.1
c.	0	300			1	6	5	2		4.6
7. a.	0	1000		2	4	8				3.7
b.	0	1000		1	7	6				3.7
c.	0	1000	1		8	5				3.2
8. a.	40	1000		6	5	1	2			2.9
b.	40	1000		2	10	1	1			2.7
c.	40	1000			8	6				3.4
9. a.	40	1000		2	5	7				3.7
b.	40	1000		1	7	6				3.7
c.	40	1000			10	4				3.3
10. a.	0	300				5	6	2		4.4
b.	0	300				5	8			6.2
c.	0	300			1	3	7	2		4.8
11. a.	40	300			3	3	7	1		4.4
b.	40	300				6	8			4.6
c.	40	300				5	5	4		4.9

(1) - (4) See Table 8 for explanation.

TABLE 8B. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 10, 1966

Type Operation: Constant Speed-Deceleration
Vehicle Speed: 40-0 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"B" Standard Responses				
			0	1	2	3	Average
1. a. (1)	0	1000	2	12			0.9
b. (2)	0	1000	1	13			0.9
c. (3)	0	1000	1	13			0.9
2. a.	40(4)	1000	1	13			0.9
b.	40	1000	1	13			0.9
c.	40	1000	1	13			0.9
3. a.	0	300	1	10	2	1	1.2
b.	0	300	1	12	1		1.0
c.	0	300		12	2		1.1
4. a.	40	100		3	10	1	1.7
b	40	100		2	11	1	1.9
c.	40	100		3	8	3	2.0
5. a.	40	100		5	7	2	1.8
b.	40	100		5	7	2	1.8
c.	40	100		2	7	5	2.2
6. a.	0	300	1	11	2		1.1
b.	0	300	1	11	2		1.1
c.	0	300		11	3		1.2
7. a.	0	1000	4	10			0.7
b.	0	1000	4	10			0.7
c.	0	1000	5	9			0.6
8. a.	40	1000	6	8			0.6
b.	40	1000	6	8			0.6
c.	40	1000	2	12			0.9
9. a.	40	1000	2	11	1		0.9
b.	40	1000	1	13			0.9
c.	40	1000		14			1.0
10. a.	0	300		7	6		2.2
b.	0	300		7	6		2.2
c.	0	300		7	6		2.2
11. a.	40	300	1	8	5		1.3
b.	40	300		13	1		1.1
c.	40	300		11	3		1.2

(1) - (4) See Table 8 for explanation.

TABLE 8C. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695	Type Operation: Constant Speed-Deceleration
Sample Method: Constant	Vehicle Speed: 40-0 mph
Date: November 10, 1966	Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"O" Standard Responses				
			0	1	2	3	Average
1. a. (1)	0	1000	4	10			0.7
b. (2)	0	1000	4	9	1		0.8
c. (3)	0	1000	6	8			0.6
2. a.	40(4)	1000	5	9			0.6
b.	40	1000	5	9			0.6
c.	40	1000	4	10			0.7
3. a.	0	300	4	9	1		0.8
b.	0	300	5	9			0.6
c.	0	300	3	10	1		0.9
4. a.	40	100	3	7	4		1.1
b.	40	100	1	8	5		1.3
c.	40	100	1	11	2		1.2
5. a.	40	100	1	6	7		1.4
b.	40	100	1	7	6		1.4
c.	40	100	3	9	1	1	1.0
6. a.	0	300	3	11			0.8
b.	0	300	3	11			0.8
c.	0	300	3	11			0.8
7. a.	0	1000	4	10			0.7
b.	0	1000	2	11	1		0.9
c.	0	1000	5	7	2		0.8
8. a.	40	1000	3	11			0.8
b.	40	1000	2	11	1		0.9
c.	40	1000	4	9	1		0.8
9. a.	40	1000	7	6	1		0.6
b.	40	1000	5	8	1		0.7
c.	40	1000	4	10			0.7
10. a.	0	300	3	8	3		0.9
b.	0	300	4	8	2		0.9
c.	0	300	5	6	2		0.7
11. a.							
b.			TIRE TROUBLE				
c.							

(1) - (4) See Table 8 for explanation.

TABLE 8D. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 10, 1966

Type Operation: Constant Speed-Deceleration
Vehicle Speed: 40-0 mph
Fuel: Reference No. 1

Run	Load	Dilution	"A" Standard Responses			
No.	HP	Ratio	0	1	2	Average
1. a. (1)	0	1000	7	6	1	0.6
b. (2)	0	1000	9	4	1	0.4
c. (3)	0	1000	10	3	1	0.4
2. a.	40(4)	1000	8	5	1	0.5
b.	40	1000	6	7	1	0.6
c.	40	1000	8	5	1	0.5
3. a.	0	300	5	8	1	0.7
b.	0	300	5	8	1	0.7
c.	0	300	6	6	2	0.7
4. a.	40	100	7	5	2	0.6
b.	40	100	8	4	2	0.6
c.	40	100	6	5	3	0.8
5. a.	40	100	6	6	2	0.7
b.	40	100	6	5	3	0.8
c.	40	100	5	4	5	1.0
6. a.	0	300	1	11	2	1.1
b.	0	300	2	11	1	0.9
c.	0	300	4	7	3	0.9
7. a.	0	1000	3	10	1	0.9
b.	0	1000	2	11	1	0.9
c.	0	1000	3	11		0.8
8. a.	40	1000	2	10	2	1.0
b.	40	1000	4	8	2	0.9
c.	40	1000	5	8	1	0.7
9. a.	40	1000	5	9		0.6
b.	40	1000	4	10		0.7
c.	40	1000	6	7	1	0.6
10. a.	0	300	5	8		0.6
b.	0	300	5	7	1	0.6
c.	0	300	5	6	2	0.7
11. a.						
b.			Tire Trouble			
c.						

(1) - (4) See Table 8 for explanation.

TABLE 8E. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 10, 1966

Type Operation: Constant Speed-Deceleration
Vehicle Speed: 40-0 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"P" Standard Responses 0	1	2	Average
1. a. (1)	0	1000	11	3		0.2
b. (2)	0	1000	9	5		0.4
c. (3)	0	1000	5	7	2	0.8
2. a.	40(4)	1000	8	6		0.4
b.	40	1000	6	8		0.6
c.	40	1000	3	10	1	0.9
3. a.	0	300	3	11		0.9
b.	0	300	4	10		0.7
c.	0	300	1	13		0.9
4. a.	40	100		11	3	1.2
b.	40	100		10	4	1.3
c.	40	100		10	4	1.3
5. a.	40	100	2	10	2	1.0
b.	40	100	3	10	1	0.9
c.	40	100	3	10	1	0.9
6. a.	0	300	11	3		0.2
b.	0	300	12	2		0.1
c.	0	300	8	6		0.4
7. a.	0	1000	14			0.0
b.	0	1000	14			0.0
c.	0	1000	14			0.0
8. a.	40	1000	13	1		0.1
b.	40	1000	14			0.0
c.	40	1000	9	5		0.4
9. a.	40	1000	12	2		0.1
b.	40	1000	12	2		0.1
c.	40	1000	7	7		0.5
10. a.	0	300	7	5	1	0.5
b.	0	300	7	6		0.4
c.	0	300	3	10		0.7
11. a.						
b.		Tire Trouble				
c.						

(1) - (4) See Table 8 for explanation.

TABLE 9. SERIES 13 PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(Bus 695 - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
3.	100	40	0	7	5	6.2	3	1	2.1	2	0	1.6	1	0	0.8	1	0	0.6
8.	100	40	0	7	3	5.9	3	1	2.0	2	1	1.7	2	0	1.2	2	0	0.3
9.	100	40	0	7	5	6.2	2	1	1.7	3	1	1.2	2	0	1.4	1	0	0.2
17.	100	40	0	7	4	6.1	3	0	3.4	2	0	1.6	3	0	1.3	1	0	0.7
						6.1			2.3			1.5			1.2			0.5
4.	100	40	40	7	6	6.2	3	2	2.2	3	0	1.7	2	0	1.2	1	0	0.5
16.	100	40	40	7	6	6.2	3	1	2.0	3	1	1.8	2	0	0.9	1	0	0.5
18.	100	40	40	7	6	6.6	3	2	2.4	3	0	1.8	2	1	1.2	1	0	0.5
						6.3			2.2			1.7			1.1			0.5
1.	300	40	0	6	5	5.7	2	1	1.8	2	0	1.3	2	0	0.9	1	0	0.3
6.	300	40	0	6	4	4.8	3	1	1.7	2	0	1.1	1	0	0.7	1	0	0.1
						5.3			1.6			1.2			0.8			0.2
10.	300	40	40	7	4	5.8	2	1	1.7	2	0	1.2	2	0	0.7	1	0	0.2
12.	300	40	40	6	4	4.8	2	0	1.1	2	0	1.0	3	0	1.2	1	0	0.1
13.	300	40	40	5	4	4.5	2	0	1.0	2	0	0.9	3	0	1.3	1	0	0.2
						5.0			1.3			1.0			1.1			0.2
5.	1000	40	0	7	3	4.0	1	1	1.0	1	0	0.6	2	0	0.8	0	0	0
11.	1000	40	0	6	2	4.0	2	0	1.1	2	0	0.9	2	0	0.3	1	0	0.9
14.	1000	40	0	4	2	2.9	1	0	0.2	1	0	0.9	3	0	0.6	1	0	0.9
15.	1000	40	0	2	0	0.2	0	0	0	1	0	0.1	1	0	0.1	0	0	0
19.	1000	40	0	4	2	3.2	1	0	0.6	2	0	1.0	2	0	0.4	1	0	0.2
20.	1000	40	0	4	2	2.9	1	0	0.5	2	0	0.9	2	0	0.4	1	0	0.2
						2.9			0.6			0.7			0.4			0.1
2.	1000	40	40	5	4	4.5	2	1	1.2	1	0	0.9	2	0	0.7	1	0	0.2
7.	1000	40	40	5	3	3.9	2	1	1.2	2	0	0.9	2	0	0.5	1	0	0.2
						4.2			1.2			0.9			0.6			0.2

(1) Constant Sampling

TABLE 9A. SERIES 13 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus
Sample Method: Constant
Date: November 11, 1966

Type Operation: Constant Speed
Vehicle Speed: 40 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"D" Composite Responses 0	1	2	3	4	5	6	7	Ave.
1.	0	300						4	9		5.7
2.	40	1000					7	6			4.5
3.	0	100						2	7	4	6.2
4.	40	100							10	3	6.2
5.	0	1000				4	7	1		1	4.0
6.	0	300					5	5	3		4.8
7.	40	1000				4	6	3			3.9
8.	0	100				1		2	6	4	5.9
9.	0	100						2	7	4	6.2
10.	40	300					1	4	5	3	5.8
11.	0	1000			1	2	7	2	1		4.0
12.	40	300					4	8	1		4.8
13.	40	300					7	6			4.5
14.	0	1000			5	5	3				2.9
15.	0	1000	12		1						0.2
16.	40	100							11	2	6.2
17.	0	100						2	8	3	6.1
18.	40	100							5	8	6.6
19.	0	1000			3	4	6				3.2
20.	0	1000			4	7	2				2.9

TABLE 9B. SERIES 13 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 11, 1966

Type Operation: Constant Speed
Vehicle Speed: 40 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"B" Smoky Responses 0	1	2	3	Average
1.	0	300		3	10		1.8
2.	40	1000		11	2		1.2
3.	0	100		1	10	2	2.0
4.	40	100			11	2	2.2
5.	0	1000		13			1.0
6.	0	300		8	4	1	1.5
7.	40	1000		11	2		1.2
8.	0	100		3	7	3	2.0
9.	0	100		4	9		1.7
10.	40	300		4	9		1.7
11.	0	1000	1	10	2		1.1
12.	40	300	1	10	2		1.1
13.	40	300	1	11	1		1.0
14.	0	1000	11	2			0.2
15.	0	1000	13				0
16.	40	100		1	11	1	2.0
17.	0	100	1	2	8	2	3.4
18.	40	100			8	5	2.4
19.	0	1000	5	8			0.6
20.	0	1000	6	7			0.5

TABLE 9C. SERIES 13 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 11, 1966

Type Operation: Constant Speed
Vehicle Speed: 40 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"O" Standard Responses 0	1	2	3	Average
1.	0	300	1	7	5		1.3
2.	40	1000	1	12			0.9
3.	0	100	1	3	9		1.6
4.	40	100	1	3	8	1	1.7
5.	0	1000	5	8			0.6
6.	0	300	2	8	3		1.1
7.	40	1000	3	9	1		0.9
8.	0	100		4	9		1.7
9.	0	100		8	4	1	1.2
10.	40	300	2	7	4		1.2
11.	0	1000	3	8	2		0.9
12.	40	300	2	9	2		1.0
13.	40	300	3	8	2		0.9
14.	0	1000	1	12			0.9
15.	0	1000	12	1			0.1
16.	40	100		4	8	1	1.8
17.	0	100	1	3	9		1.6
18.	40	100	1	3	7	2	1.8
19.	0	1000	2	9	2		1.0
20.	0	1000	3	9	1		0.9

TABLE 9D. SERIES 13 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: 40 mph
Date: November 11, 1966	Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"A" Standard Responses 0	1	2	3	Average
1.	0	300	2	10	1		0.9
2.	40	1000	4	9			0.7
3.	0	100	2	11			0.8
4.	40	100	1	8	4		1.2
5.	0	1000	4	7	2		0.8
6.	0	300	4	9			0.7
7.	40	1000	7	5	1		0.5
8.	0	100	1	8	4		1.2
9.	0	100	1	6	6		1.4
10.	40	300	5	7	1		0.7
11.	0	1000	10	2	1		0.3
12.	40	300	3	6	3	1	1.2
13.	40	300	2	6	4	1	1.3
14.	0	1000	7	5		1	0.6
15.	0	1000	12	1			0.1
16.	40	100	2	10	1		0.9
17.	0	100	1	8	3	1	1.3
18.	40	100		10	3		1.2
19.	0	1000	9	3	1		0.4
20.	0	1000	9	3	1		0.4

TABLE 9E. SERIES 13 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 11, 1966

Type Operation: Constant Speed
Vehicle Speed: 40 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"P" Standard Responses 0	1	2	Average
1.	0	300	9	4		0.3
2.	40	1000	10	3		0.2
3.	0	100	5	8		0.6
4.	40	100	7	6		0.5
5.	0	1000	13			0
6.	0	300	12	1		0.1
7.	40	1000	10	3		0.2
8.	0	100	10	2	1	0.3
9.	0	100	10	3		0.2
10.	40	300	11	2		0.2
11.	0	1000	12	1		0.1
12.	40	300	12	1		0.1
13.	40	300	10	3		0.2
14.	0	1000	12	1		0.1
15.	0	1000	13			0
16.	40	100	6	7		0.5
17.	0	100	4	9		0.7
18.	40	100	7	6		0.5
19.	0	1000	11	2		0.2
20.	0	1000	11	2		0.2

TABLE 10. SERIES 14 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Bus 695 - Idle-Acceleration)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
3. c.	300	0-35	30	6	5	6.2	2	1	1.6	2	0	1.3	2	0	1.1	1	0	0.5
4. c.	300	0-35	30	6	5	5.7	3	1	1.5	2	0	1.2	1	0	0.8	1	0	0.3
14. c.	300	0-35	30	6	5	5.5	3	1	1.4	2	0	1.1	2	0	1.0	1	0	0.5
						5.6			1.5			1.2			1.0			0.4
5. a.	1000	0-35	0	6	2	4.1	3	0	1.1	2	0	0.7	2	0	0.5	0	0	0
6. a.	1000	0-35	0	4	3	3.7	1	0	0.9	2	0	0.8	1	0	0.2	1	0	0.0
						3.9			1.0			0.8			0.4			0.0
5. b.	1000	0-35	0	5	2	3.2	1	0	0.7	2	0	0.7	1	0	0.5	0	0	0
6. b.	1000	0-35	0	3	2	2.9	1	0	0.7	1	0	0.8	1	0	0.2	0	0	0
						3.0			0.7			0.7			0.4			0
5. c.	1000	0-35	0	5	2	2.8	1	0	0.6	2	0	0.6	1	0	0.3	0	0	0
6. c.	1000	0-35	0	3	2	2.4	1	0	0.7	2	0	0.6	1	0	0.1	0	0	0
						2.6			0.7			0.7			0.3			0
1. a.	1000	0-35	30	6	4	5.5	2	1	1.8	2	0	1.1	1	0	0.8	1	0	0.3
8. a.	1000	0-35	30	5	3	3.8	2	1	1.0	2	0	1.0	1	0	0.2	0	0	0
9. a.	1000	0-35	30	6	3	4.9	2	1	1.3	2	0	0.9	1	0	0.5	1	0	0.2
10. a.	1000	0-35	30	6	4	4.8	2	1	1.2	2	0	0.8	2	0	1.0	0	0	0
						4.8			1.3			0.9			0.6			0.1
1. b.	1000	0-35	30	5	4	4.7	2	1	1.2	1	0	0.9	1	0	0.7	1	0	0.2
8. b.	1000	0-35	30	5	2	3.0	1	0	0.9	1	0	0.6	1	0	0.2	0	0	0
9.b.	1000	0-35	30	6	3	4.5	2	1	1.0	1	0	0.8	1	0	0.5	1	0	0.1
10. b.	1000	0-35	30	6	3	4.2	2	0	0.9	2	0	0.9	2	0	0.9	1	0	0.1
						4.1			1.0			0.8			0.6			0.1
1. c.	1000	0-35	30	6	4	4.5	2	1	1.2	1	0	0.9	1	0	0.6	1	0	0.2
8. c.	1000	0-35	30	3	1	2.7	1	0	0.7	1	0	0.6	1	0	0.3	0	0	0
9. c.	1000	0-35	30	5	3	4.2	1	1	1.0	1	0	0.7	2	0	0.5	1	0	0.1
10. c.	1000	0-35	30	5	3	4.1	1	0	0.8	2	0	0.8	2	0	1.0	1	0	0.2
						3.9			0.9			0.8			0.8			0.1

(1) "a" exposure is 3 seconds after start of open rack acceleration
(2) "b" exposure is 5 seconds after upshift
(3) "c" exposure is on reaching 35 mph
(4) Load is impressed at 30 mph and left in dynamometer throughout acceleration
(5) Constant Sampling

TABLE 10. SERIES 14 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Idle-Acceleration)

Run No.	Dilution Ratio(5)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
2. a. (1)	100	0-35	0	7	6	6.8	3	2	2.2	2	0	1.7	2	0	1.0	1	0	0.6
7. a.	100	0-35	0	7	6	6.9	3	1	2.3	2	0	1.6	2	0	1.0	1	0	0.6
						6.8			2.2			1.7			1.0			0.6
2. b. (2)	100	0-35	0	7	6	6.7	3	2	2.2	2	0	1.6	1	0	0.8	1	0	0.7
7. b.	100	0-35	0	7	6	6.6	3	1	2.1	3	0	1.6	2	0	1.0	1	0	0.6
						6.7			2.1			1.6			0.9			0.7
2. c. (3)	100	0-35	0	7	6	6.8	3	2	2.2	2	0	1.6	2	0	0.9	1	0	0.5
7. c.	100	0-35	0	7	5	6.5	3	1	2.0	2	0	1.5	2	0	1.0	1	0	0.5
						6.7			2.1			1.5			0.9			0.5
11. a.	100	0-35	30(4)	7	6	6.9	3	2	2.4	2	0	1.6	2	0	1.1	1	0	0.5
12. a.	100	0-35	30	7	6	6.3	3	1	2.1	2	0	1.2	3	1	1.5	1	0	0.5
						6.6			2.2			1.4			1.3			0.5
11. b.	100	0-35	30	7	6	6.9	3	2	2.5	2	0	1.5	2	1	1.2	1	0	0.5
12. b.	100	0-35	30	7	6	6.2	3	0	1.9	2	0	1.1	2	1	1.6	1	0	0.5
						6.6			[illegible]			1.3			1.4			0.5
11. c.	100	0-35	30	8	6	7.0	3	1	2.5	2	0	1.5	2	0	1.3	2	0	0.7
12. c.	100	0-35	30	7	6	6.4	3	0	1.9	2	0	1.2	2	0	1.2	2	0	0.6
						6.7			2.2			1.3			1.3			0.6
13. a.	300	0-35	0	7	5	5.9	3	1	1.8	3	0	1.3	2	0	0.7	1	0	0.5
13. b.	300	0-35	0	6	4	5.2	2	1	1.5	2	0	1.2	1	0	0.7	1	0	0.5
13. c.	300	0-35	0	6	4	4.9	2	1	1.2	2	0	1.1	1	0	0.5	1	0	0.4
3. a.	300	0-35	30	7	6	5.9	3	1	1.8	2	0	1.5	1	0	0.9	1	0	0.5
4. a.	300	0. 35	30	7	5	6.1	2	0	1.8	3	0	1.4	2	0	1.0	1	0	0.2
14. a.	300	0-35	30	8	5	6.3	3	1	1.9	2	0	1.5	2	0	1.1	2	0	0.5
						6.1			1.8			1.5			1.0			0.4
3. b.	300	0-35	30	6	5	5.5	2	1	1.6	2	0	1.3	1	0	0.9	1	0	0.5
4. b.	300	0-35	30	6	5	5.7	2	1	1.5	3	0	1.3	1	0	0.7	1	0	0.3
14. b.	300	0-35	30	7	5	5.6	2	1	1.6	2	0	1.3	2	0	1.0	2	0	0.4
						5.6			1.6			1.3			0.7			0.4

TABLE 10A. SERIES 14 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695	Type Operation: Idle-Acceleration
Sample Method: Constant	Vehicle Speed: 0-35 mph
Date: November 14, 1966	Fuel: Reference No. 1

Run	Load	Dilution	"D" Composite Responses								
No.	HP	Ratio	1	2	3	4	5	6	7	8	Average
1. a. (1)	30(4)	1000				1	5	7			5.5
b. (2)	30	1000				4	9				4.7
c. (3)	30	1000				8	3	2			4.5
2. a.	0	100						3	10		6.8
b.	0	100						4	9		6.7
c.	0	100						3	10		6.8
3. a.	30	300					2	10	1		5.9
b.	30	300					7	6			5.5
c.	30	300					5	8			6.2
4. a.	30	300					1	10	2		6.1
b.	30	300					4	9			5.7
c.	30	300					4	9			5.7
5. a.	0	1000		1	3	4	4	1			4.7
b.	0	1000		3	6	2	2				3.2
c.	0	1000		9		2	2				2.8
6. a.	0	1000			4	9					3.7
b.	0	1000		2	11						2.9
c.	0	1000		8	5						2.4
7. a.	0	100						1	12		6.9
b.	0	100						5	8		6.6
c.	0	100					1	4	8		6.5
8. a.	30	1000			4	8	1				3.8
b.	30	1000		2	9	2					3.0
c.	30	1000	1	2	10						2.7
9. a.	30	1000			2	2	4	5			4.9
b.	30	1000			1	5	6	1			4.5
c.	30	1000			1	8	4				4.2
10. a.	30	1000				4	7	2			4.8
b.	30	1000			2	8	2	1			4.2
c.	30	1000			3	6	4				4.1
11. a.	30	100						2	11		6.9
b.	30	100						1	12		6.9
c.	30	100						1	10	2	7.0
12. a.	30	100						9	4		6.3
b.	30	100						10	3		6.2
c.	30	100						8	5		6.4
13. a.	0	300					4	7	2		5.9
b.	0	300				2	6	5			5.2
c.	0	300				3	9	1			4.9
14. a.	30	300					2	6	4	1	6.3
b.	30	300					7	4	2		5.6
c.	30	300					6	7			5.5

(1) - (4) See Table 10 for explanation.

TABLE 10B. SERIES 14 PROCEDURAL DEVELOPMENT RESULTS

(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 14, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"B" Standard Responses 0	1	2	3	Ave.
1. a. (1)	30(4)	1000		3	10		1. 8
b. (2)	30	1000		11	2		1. 2
c. (3)	30	1000		10	3		1. 2
2. a.	0	100			11	2	2. 2
b.	0	100			11	2	2. 2
c.	0	100			11	2	2. 2
3. a.	30	300		2	10	1	1. 8
b.	30	300		5	8		1. 6
c.	30	300		5	8		1. 6
4. a.	30	300	1	2	10		1. 8
b.	30	300		7	6		1. 5
c.	30	300		7	5	1	1. 5
5. a.	0	1000	1	10	1	1	1. 4
b.	0	1000	4	9			0. 7
c.	0	1000	5	8			0. 6
6. a.	0	1000	2	11			0. 9
b.	0	1000	4	9			0. 7
c.	0	1000	4	9			0. 7
7. a.	0	100		1	7	5	2. 3
b.	0	100		2	8	3	2. 9
c.	0	100		3	7	3	2. 0
8. a.	30	1000		12	1		1. 1
b	30	1000	1	12			0. 9
c.	30	1000	4	9			0. 7
9. a.	30	1000		9	4		1. 3
b.	30	1000		12	1		1. 1
c.	30	1000		13			1. 0
10. a.	30	1000		11	2		1. 2
b.	30	1000	2	10	1		0. 9
c.	30	1000	3	10			0. 8
11. a.	30	100			8	5	2. 4
b.	30	100			7	6	2. 5
c.	30	100		1	5	7	2. 5
12. a.	30	100		1	10	2	2. 1
b.	30	100	1	2	7	3	1. 9
c.	30	100	1	2	8	2	1. 9
13. a.	0	300		5	6	2	1. 8
b.	0	300		7	6		1. 5
c.	0	300		10	3		1. 2
14. a.	30	300		2	10	1	1. 9
b.	30	300		5	8		1. 6
c.	30	300		9	3	1	1. 4

(1) - (4) See Table 10 for explanation.

TABLE 10C. SERIES 14 PROCEDURAL DEVELOPMENT RESULTS

(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 14, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"O" Standard Responses 0	1	2	3	Average
1. a. (1)	30(4)	1000	1	10	2		1.1
b. (2)	30	1000	1	12			0.9
c. (3)	30	1000	1	12			0.9
2. a.	0	100	1	2	10		1.7
b.	0	100	1	3	9		1.6
c.	0	100	1	3	9		1.6
3. a.	30	300	1	4	8		1.5
b.	30	300	1	6	6		1.4
c.	30	300	1	7	5		1.3
4. a.	30	300	1	7	4	1	1.4
b.	30	300	1	8	3	1	1.3
c.	30	300	1	8	4		1.2
5. a.	0	1000	5	6	2		0.8
b.	0	1000	6	5	2		0.7
c.	0	1000	6	6	1		0.6
6. a.	0	1000	3	9	1		0.9
b.	0	1000	3	10			0.8
c.	0	1000	5	7	1		0.7
7. a.	0	100	1	3	9		1.6
b.	0	100	1	4	7	1	1.6
c.	0	100	1	5	7		1.5
8. a.	30	1000	2	9	2		1.0
b.	30	1000	5	8			0.6
c.	30	1000	5	8			0.6
9. a.	30	1000	2	10	1		0.9
b.	30	1000	3	10			0.8
c.	30	1000	4	9			0.7
10. a.	30	1000	4	8	1		0.8
b.	30	1000	4	6	3		0.9
c.	30	1000	4	7	2		0.9
11. a.	30	100	1	3	9		1.6
b.	30	100	1	5	7		1.5
c.	30	100	1	5	7		1.5
12. a.	30	100	1	9	3		1.2
b.	30	100	1	10	2		1.1
c.	30	100	1	9	3		1.2
13. a.	0	300	1	8	3	1	1.3
b.	0	300	1	9	3		1.2
c.	0	300	1	10	2		1.1
14. a.	30	300	1	4	8		1.5
b.	30	300	2	5	6		1.3
c.	30	300	1	9	3		1.2

(1) - (4) See Table 10 for explanation.

TABLE 10D. SERIES 14 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695	Type Operation: Idle-Acceleration
Sample Method: Constant	Vehicle Speed: 0-35 mph
Date: November 14, 1966	Fuel: Reference No. 1

Run	Load	Dilution	"A" Standard Responses			
No.	HP	Ratio	0	1	2	Average
1. a. (1)	30(4)	1000	3	10		0.8
b. (2)	30	1000	3	10		0.8
c. (3)	30	1000	5	8		0.6
2. a.	0	100	1	11	1	1.0
b.	0	100	3	10		0.8
c.	0	100	2	10	1	0.9
3. a.	30	300	2	11		0.9
b.	30	300	2	11		0.9
c.	30	300	1	10	2	1.1
4. a.	30	300	2	9	2	1.0
b.	30	300	3	10		0.8
c.	30	300	3	10		0.8
5. a.	0	1000	8	4	1	0.5
b.	0	1000	7	6		0.5
c.	0	1000	8	5		0.4
6. a.	0	1000	10	3		0.2
b.	0	1000	10	3		0.2
c.	0	1000	11	2		0.2
7. a.	0	100	1	11	1	1.0
b.	0	100	1	11	1	1.0
c.	0	100	1	11	1	1.0
8. a.	30	1000	11	2		0.2
b.	30	1000	10	3		0.2
c.	30	1000	9	4		0.3
9. a.	30	1000	6	7		0.5
b.	30	1000	6	7		0.5
c.	30	1000	7	5		0.5
10. a.	30	1000	1	11	1	1.0
b.	30	1000	2	10	1	0.9
c.	30	1000	1	11	1	1.0
11. a.	30	100	1	10	2	1.1
b.	30	100		10	3	1.2
c.	30	100	1	7	5	1.3
12. a.	30	100		7	6	1.5
b.	30	100		5	8	1.6
c.	30	100	2	6	5	1.2
13. a.	0	300	5	7	1	0.7
b.	0	300	4	9		0.7
c.	0	300	4	9		0.7
14. a.	30	300	1	9	3	1.2
b.	30	300		12	1	1.1
c.	30	300		12	1	1.1

(1) - (4) See Table 10 for explanation.

TABLE 10E. SERIES 14 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 14, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run	Load	Dilution	"P" Standard Responses			
No.	HP	Ratio	0	1	2	Average
1. a. (1)	30(4)	1000	9	4		0. 3
b. (2)	30	1000	10	3		0. 2
c. (3)	30	1000	10	3		0. 2
2. a.	0	100	5	8		0. 6
b.	0	100	4	9		0. 7
c.	0	100	5	7		0. 5
3. a.	30	300	6	7		0. 5
b.	30	300	7	6		0. 5
c.	30	300	7	6		0. 5
4. a.	30	300	10	3		0. 2
b.	30	300	9	4		0. 3
c.	30	300	9	4		0. 3
5. a.	0	1000	13			0. 0
b.	0	1000	13			0. 0
c.	0	1000	13			0. 0
6. a.	0	1000	12	1		0. 1
b.	0	1000	13			0. 0
c.	0	1000	13			0. 0
7. a.	0	100	5	8		0. 6
b.	0	100	5	8		0. 6
c.	0	100	7	6		0. 5
8. a.	30	1000	13			0. 0
b.	30	1000	13			0. 0
c.	30	1000	13			0. 0
9. a.	30	1000	10	3		0. 2
b.	30	1000	12	1		0. 1
c.	30	1000	12	1		0. 1
10. a.	30	1000	13			0. 0
b.	30	1000	12	1		0. 1
c.	30	1000	11	2		0. 2
11. a.	30	100	7	6		0. 5
b.	30	100	6	7		0. 5
c.	30	100	6	5	2	0. 7
12. a.	30	100	7	6		0. 5
b.	30	100	7	6		0. 5
c.	30	100	6	6	1	0. 6
13. a.	0	300	7	6		0. 5
b.	0	300	7	6		0. 5
c.	0	300	8	5		0. 4
14. a.	30	300	4	6	3	0. 5
b.	30	300	7	5	1	0. 4
c.	30	300	6	7		0. 5

(1) - (4) See Table 10 for explanation.

TABLE 11. SERIES 15 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
9.	100	30	0	7	5	6.2	3	1	2.1	3	1	2.0	1	0	0.7	1	0	0.6
11.	100	30	0	7	4	5.7	3	1	1.9	3	0	1.5	2	0	1.2	1	0	0.2
19.	100	30	0	7	5	6.0	3	1	1.1	3	0	1.1	2	0	0.9	1	0	0.6
28.	100	30	0	6	5	4.9	3	1	1.1	3	1	1.1	1	0	0.8	1	0	0.5
						5.7			1.5			1.4			0.9			0.5
3.	100	30	30	7	4	4.6	3	0	1.6	2	0	0.9	1	0	0.8	1	0	0.2
6.	100	30	30	7	4	6.0	3	1	2.0	2	0	1.6	1	0	0.8	1	0	0.5
12.	100	30	30	6	5	5.9	3	0	1.8	2	0	1.4	2	0	1.2	1	0	0.3
18.	100	30	30	7	6	6.4	3	0	2.0	3	0	1.0	2	0	1.2	1	0	0.5
						5.7			1.9			1.3			1.0			0.4
24.	100	30	40	6	6	6.0	3	2	2.1	2	1	1.6	2	0	0.9	1	0	0.6
26.	100	30	40	7	4	5.8	3	1	2.2	2	1	1.3	2	0	0.9	1	0	0.6
						5.9			2.1			1.5			0.9			0.6
7.	300	30	0	5	3	4.5	2	1	1.3	2	0	1.1	1	0	0.7	1	0	0.1
17.	300	30	0	5	3	4.0	2	0	1.1	2	0	0.8	2	0	0.9	1	0	0.2
22.	300	30	0	5	3	3.9	2	0	1.1	2	0	0.2	1	0	0.5	1	0	0.2
						4.1			1.2			0.7			0.7			0.1
1.	300	30	30	6	3	4.6	2	1	1.5	2	0	1.3	1	0	0.5	0	0	0
8.	300	30	30	5	4	4.6	2	1	1.3	2	0	1.1	1	0	0.5	1	0	1.1
14.	300	30	30	6	3	4.7	2	0	1.2	3	0	1.1	2	0	1.1	1	0	0.3
16.	300	30	30	5	3	3.9	2	0	1.1	2	0	0.8	2	0	0.9	0	0	0
21.	300	30	30	5	3	4.3	2	1	1.2	2	0	1.1	1	0	0.6	1	0	0.3
						4.4			1.2			1.1			0.7			0.3
27.	300	30	40	4	3	3.3	2	0	0.9	2	0	0.8	1	0	0.7	0	0	0
2.	1000	30	0	5	3	3.5	1	0	0.9	2	0	0.9	1	0	0.4	0	0	0
4.	1000	30	0	5	3	3.9	2	0	1.1	2	0	0.9	1	0	0.6	0	0	0
5.	1000	30	0	5	3	3.9	2	0	1.0	2	0	1.0	1	0	0.5	1	0	0.2
13.	1000	30	0	4	3	3.8	2	0	0.9	2	0	0.9	1	0	0.6	1	0	0.1
15.	1000	30	0	5	3	3.7	2	0	0.9	2	0	0.9	1	0	0.7	1	0	0.1
25.	1000	30	0	3	2	2.8	1	0	0.8	1	0	0.5	1	0	0.3	1	0	0.1
						3.6			1.0			0.9			0.5			0.1
10.	1000	30	30	5	3	4.2	2	1	1.1	1	0	0.9	2	0	1.2	1	0	0.2
20.	1000	30	30	4	3	4.7	2	0	1.0	2	0	1.0	1	0	0.6	1	0	0.1
						4.5			1.0			0.9			0.9			0.1
23.	1000	30	40	6	3	4.4	3	1	1.5	2	0	1.2	1	0	0.6	0	0	0
29.	1000	30	40	6	2	3.4	2	0	1.0	2	0	0.7	1	0	0.4	0	0	0
30.	1000	30	40	3	2	3.3	1	1	1.0	1	0	0.7	2	0	0.3	1	0	0.1
						3.7			1.1			0.8			0.4			0.0

(1) Constant Sampling

TABLE 11A. SERIES 15 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 15, 1966

Type Operation: Constant Speed
Vehicle Speed: 30 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"D" Composite Responses						
			2	3	4	5	6	7	Average
1.	30	300		3	2	5	3		4.6
2.	0	1000		8	3	2			3.5
3.	30	100			1	3	6	3	4.6
4.	0	1000		4	7	2			3.9
5.	0	1000		4	7	2			3.9
6.	30	100			1	1	8	3	6.0
7.	0	300		1	5	7			4.5
8.	30	300			5	8			4.6
9.	0	100				1	9	3	6.2
10.	30	1000		2	6	5			4.2
11.	0	100			2	2	7	2	5.7
12.	30	100				2	11		5.9
13.	0	1000		6	7				3.8
14.	30	300		3	1	5	3		4.7
15.	0	1000		5	6	1			3.7
16.	30	300		3	7	2			3.9
17.	0	300		4	4	4			4.0
18.	30	100					7	5	6.4
19.	0	100				4	4	4	6.0
20.	30	1000		4	8				4.7
21.	30	300		2	5	5			4.3
22.	0	300		2	9	1			3.9
23.	40	1000		1	6	4	1		4.4
24.	40	100					12		6.0
25.	0	1000	3	9					2.8
26.	40	100			1	1	9	1	5.8
27.	40	300		8	4				3.3
28.	0	100				3	9		5.8
29.	40	1000	1	5	6				3.4
30.	40	1000	2	10					3.3

TABLE 11B. SERIES 15 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 15, 1966

Type Operation: Constant Speed
Vehicle Speed: 30 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"B" Burnt Responses				
			0	1	2	3	Average
1.	30	300		7	6		1.5
2.	0	1000	1	12			0.9
3.	30	100	1	5	5	2	1.6
4.	0	1000	1	10	2		1.1
5.	0	1000	1	11	1		1.0
6.	30	100		2	9	2	2.0
7.	0	300		9	4		1.3
8.	30	100		9	4		1.3
9.	0	1000		1	10	2	2.1
10.	30	100		12	1		1.1
11.	0	100		3	9	1	1.9
12.	30	1000	1	2	9	1	1.8
13.	0	300	3	8	2		0.9
14.	30	1000	4	2	6		1.2
15.	0	300	3	7	2		0.9
16.	30	300	3	6	3		1.1
17.	0	300	3	5	4		1.1
18.	30	100	1	2	5	4	2.0
19.	0	100		3	7	2	1.1
20.	30	1000	1	10	1		1.0
21.	30	300		10	2		1.2
22.	0	300	1	9	2		1.1
23.	40	1000		7	4	1	1.5
24.	40	100			9	3	2.1
25.	0	1000	3	9			0.8
26.	40	100		1	8	3	2.2
27.	40	300	2	9	1		0.9
28.	0	100		5	6	1	1.1
29.	40	1000	1	10	1		1.0
30.	40	1000		12			1.0

TABLE 11C. SERIES 15 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 15, 1966

Type Operation: Constant Speed
Vehicle Speed: 30 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"O" Oily Responses 0	1	2	3	Average
1.	30	300	2	5	6		1. 3
2.	0	1000	2	10	1		0. 9
3.	30	100	1	4	8		0. 9
4.	0	1000	3	9	1		0. 9
5.	0	1000	3	7	3		1. 0
6.	30	100	1	3	9		1. 6
7.	0	300	2	8	3		1. 1
8.	30	100	2	8	3		1. 1
9.	0	1000		2	9	2	2. 0
10.	30	100	2	11			0. 9
11.	0	100	2	3	7	1	1. 5
12.	30	1000	1	6	6		1. 4
13.	0	300	2	10	1		0. 9
14.	30	1000	2	8	1	1	1. 1
15.	0	300	2	8	2		0. 9
16.	30	300	3	8	1		0. 8
17.	0	300	3	8	1		0. 8
18.	30	100	1	1	9	1	1. 1
19.	0	100	1	3	7	1	1. 1
20.	30	1000	2	8	2		1. 0
21.	30	300	2	7	3		1. 1
22.	0	300	1	8	3		1. 1
23.	40	1000	1	8	3		1. 2
24.	40	100		5	7		1. 6
25.	0	1000	6	6			0. 5
26.	40	100		8	4		1. 3
27.	40	300	4	7	1		0. 8
28.	0	100		2	9	1	1. 1
29.	40	1000	5	6	1		0. 7
30.	40	1000	4	8			0. 7

TABLE 11D. SERIES 15 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: 30 mph
Date: November 15, 1966	Fuel: Reference No. 1

Run	Load	Dilution	"A" Aromatic Responses			
No.	HP	Ratio	0	1	2	Average
1.	30	300	6	7		0.5
2.	0	1000	8	5		0.4
3.	30	100	3	10		0.8
4.	0	1000	5	8		0.6
5.	0	1000	7	6		0.5
6.	30	100	3	10		0.8
7.	0	300	4	9		0.7
8.	30	100	7	6		0.5
9.	0	1000	4	9		0.7
10.	30	100	3	6	4	1.2
11.	0	100	1	9	3	1.2
12.	30	1000	1	9	3	1.2
13.	0	300	5	8		0.6
14.	30	1000	2	7	3	1.1
15.	0	300	4	8		0.7
16.	30	300	1	10	1	0.9
17.	0	300	3	7	2	0.9
18.	30	100	1	8	3	1.2
19.	0	100	2	8	2	0.9
20.	30	1000	5	7		0.6
21.	30	300	5	7		0.6
22.	0	300	6	6		0.5
23.	40	1000	5	7		0.6
24.	40	100	2	8	2	0.9
25.	0	1000	8	4		0.3
26	40	100	1	10	1	0.9
27.	40	300	3	8	1	0.7
28.	0	100	3	9		0.8
29.	40	1000	7	5		0.4
30.	40	1000	9	2	1	0.3

TABLE 11E. SERIES 15 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: 30 mph
Date: November 15, 1966	Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"P" Pungent Responses 0	1	Average
1.	30	300	13		0. 0
2.	0	1000	13		0. 0
3.	30	100	11	2	0. 2
4.	0	1000	13		0. 0
5.	0	1000	11	2	0. 2
6.	30	100	7	6	0. 5
7.	0	300	12	1	0. 1
8.	30	300	12	1	0. 1
9.	0	100	5	8	0. 6
10.	30	1000	11	2	0. 2
11.	0	100	10	3	0. 2
12.	30	100	9	4	0. 3
13.	0	1000	12	1	0. 1
14.	30	300	9	3	0. 3
15.	0	1000	11	1	0. 1
16.	30	300	12		0. 0
17.	0	300	10	2	0. 2
18.	30	100	6	6	0. 5
19.	0	100	5	7	0. 6
20.	30	1000	11	1	0. 1
21.	30	300	9	3	0. 3
22.	0	300	10	2	0. 2
23.	40	1000	12		0. 0
24.	40	100	5	7	0. 6
25.	0	1000	11	1	0. 1
26.	40	100	5	7	0. 6
27.	40	300	12		0. 0
28.	0	100	6	6	0. 5
29.	40	1000	12		0. 0
30.	40	1000	11	1	0. 1

TABLE 12. SERIES 16 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Idle-Acceleration)

Run No.	Dilution Ratio(5)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
4. a. (1)	110	0-35	0	6	4	5.6	2	1	1.9	2	0	1.5	2	0	1.0	1	0	0.2
11. a.	110	0-35	0	7	5	5.5	3	1	1.6	3	0	1.5	2	0	0.9	1	0	0.5
						5.5			1.7			1.5			1.0			0.3
1. a.	110	0-35	30(4)	6	4	5.7	3	1	1.9	2	0	1.7	2	0	0.9	1	0	0.5
2. a.	110	0-35	30	6	5	5.6	2	1	1.9	2	0	1.6	2	0	1.0	1	0	0.3
9. a.	110	0-35	30	7	6	6.5	3	0	2.2	3	0	1.7	2	1	1.3	2	0	0.8
						5.9			2.0			1.7			1.1			0.5
1. c. (3)	120	0-35	30	6	4	5.0	2	1	1.5	2	0	1.2	2	0	1.0	1	0	0.4
2. c.	120	0-35	30	6	4	4.9	2	1	1.3	2	0	1.1	2	0	1.2	1	0	0.3
9. c.	120	0-35	30	7	5	6.4	3	1	2.1	3	0	1.5	2	0	1.2	1	0	0.8
						5.3			1.6			1.2			1.1			0.5
4. c.	130	0-35	0	6	4	5.1	2	1	1.5	2	0	1.1	1	0	0.9	1	0	0.2
11. c.	130	0-35	0	7	5	5.5	3	1	1.5	2	0	1.3	2	0	1.0	1	0	0.5
						5.3			1.5			1.2			1.0			0.4
4. b. (2)	140	0-35	0	6	4	4.9	2	1	1.5	2	0	1.0	1	0	0.9	1	0	0.2
11. b.	140	0-35	0	6	5	5.4	2	1	1.5	2	0	1.2	2	0	0.9	1	0	0.5
						5.1			1.5			1.1			0.9			0.3
1. b.	150	0-35	30	6	4	5.4	2	1	1.6	2	0	1.8	2	0	1.2	1	0	0.3
2. b.	150	0-35	30	6	4	5.0	2	1	1.5	2	0	1.2	2	0	1.1	1	0	0.2
9. b.	150	0-35	30	7	5	6.0	3	1	1.9	2	0	1.5	2	0	1.4	1	0	0.5
						5.5			1.7			1.5			1.5			0.3
3. a.	300	0-35	30	5	3	4.2	2	1	1.1	2	0	0.9	1	0	0.5	1	0	0.2
7. a.	300	0-35	30	6	4	4.9	2	0	1.5	2	0	1.0	2	0	0.9	1	0	0.1
8. a.	300	0-35	30	6	3	4.1	3	1	1.5	2	0	1.1	2	0	0.8	1	0	0.2
10. a.	300	0-35	30	6	4	5.0	3	0	1.6	2	0	0.9	2	0	1.0	1	0	0.2
13. a.	300	0-35	30	5	4	4.7	2	1	1.2	2	0	1.0	1	0	0.6	1	0	0.4
						4.6			1.4			1.0			0.8			0.2
3. c.	350	0-35	30	4	2	3.4	2	0	0.9	1	0	0.9	2	0	0.6	1	0	0.1
7. c.	350	0-35	30	6	3	4.1	2	1	1.2	2	0	1.1	1	0	0.8	1	0	0.2
8. c.	350	0-35	30	5	3	4.2	2	0	1.0	2	0	1.0	2	1	0.7	1	0	0.2
10. c.	350	0-35	30	6	3	4.0	2	1	1.1	1	0	0.9	2	0	0.9	1	0	0.2
13. c.	350	0-35	30	5	4	4.5	2	1	1.2	1	0	0.9	2	0	0.9	1	0	0.6
						4.0			1.1			0.9			0.8			0.2

TABLE 12. SERIES 16 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Bus 695 - Idle-Acceleration)

Run No.	Dilution Ratio(5)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
3. b.	440	0-35	30	5	2	3.5	2	0	1.0	1	0	0.9	1	0	0.4	1	0	0.2
7. b.	440	0-35	30	6	4	4.4	2	0	1.2	2	0	0.9	2	0	0.7	1	0	0.1
8. b.	440	0-35	30	6	3	4.5	2	1	1.3	2	0	1.1	2	0	0.8	1	0	0.2
10. b.	440	0-35	30	6	4	4.5	2	0	1.2	2	0	0.9	2	0	0.9	1	0	0.1
13. b.	440	0-35	30	5	3	4.2	2	1	1.9	1	0	0.9	1	0	0.5	1	0	0.4
						4.3			1.3			0.9			0.7			0.2
6. a.	990	0-35	0	5	3	4.1	1	0	0.9	1	0	0.7	1	0	0.6	0	0	0
5. a.	990	0-35	30	5	3	3.8	1	0	0.9	1	0	0.8	1	0	0.7	1	0	0.2
12. a.	990	0-35	30	4	3	3.7	2	0	1.1	2	0	0.8	1	0	0.5	1	0	0.1
14. a.	990	0-35	30	5	3	3.9	2	0	0.9	1	0	0.7	1	0	0.7	1	0	0.2
						3.8			1.0			0.7			0.6			0.1
6. b.	1400	0-35	0	5	2	3.6	1	0	0.9	1	0	0.7	1	0	0.7	1	0	0.1
5. b.	1400	0-35	30	4	2	3.2	1	0	0.8	1	0	0.6	1	0	0.5	1	0	0.2
12. b.	1400	0-35	30	4	3	3.2	2	0	0.9	1	0	0.7	1	0	0.5	1	0	0.1
14. b.	1400	0-35	30	5	3	3.5	2	0	0.9	1	0	0.5	1	0	0.7	1	0	0.2
						3.3			0.8			0.6			0.6			0.1
6. c.	1140	0-35	0	5	2	3.0	1	0	0.8	1	0	0.8	1	0	0.5	0	0	0
5. c.	1140	0-35	30	4	2	2.9	1	0	0.5	1	0	0.7	1	0	0.5	1	0	0.1
12. c.	1140	0-35	30	5	2	3.1	1	0	0.8	1	0	0.7	1	0	0.5	0	0	0
14. c.	1140	0-35	30	4	3	3.2	2	0	0.9	1	0	0.5	1	0	0.6	1	0	0.2
						3.1			0.7			0.6			0.2			0.1

(1) "a" exposure is 3 seconds after start of open rack acceleration

(2) "b" exposure is 5 seconds after upshift

(3) "c" exposure is on reaching 35 mph

(4) Load is impressed at 30 mph and left in dynamometer throughout acceleration

(5) Proportional Sampling

TABLE 12A. SERIES 16 PROCEDURAL DEVELOPMENT RESULTS

(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Proportional
Date: November 16, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	"D" Composite Responses 2	3	4	5	6	7	Average
1. a. (1)	30(4)	110			1	2	10		5.7
b. (2)	30	150			1	7	5		5.4
c. (3)	30	120			3	7	3		5.0
2. a.	30	110				5	8		5.6
b.	30	150			1	11	1		5.0
c.	30	120			3	9	1		4.9
3. a.	30	300		3	4	6			4.2
b.	30	440	1	3	8	1			3.5
c.	30	350	1	6	6				3.4
4. a.	30	110			1	3	9		5.6
b.	30	140			2	10	1		4.9
c.	30	130			1	10	2		5.1
5. a.	30	990		5	6	2			3.8
b.	30	1400	1	9	3				3.2
c.	30	1 140	2	10	1				2.9
6. a.	30	990	1	10	2				4.1
b.	30	1400		1	10	2			3.6
c.	30	1140	1	3	9				3.0
7. a.	30	300	1	11	1				4.9
b.	30	440			4	7	2		4.4
c.	30	350			9	3	1		4.1
8. a.	30	300		5	3	4	1		4.1
b.	30	440		1	3	6	3		4.5
c.	30	350		2	3	7	1		4.1
9. a.	30	110					7	6	6.5
b.	30	150				2	9	2	6.0
c.	30	120				1	6	6	6.4
10. a.	30	300			3	7	3		5.0
b.	30	440			7	5	1		4.5
c.	30	350		3	8	1	1		4.0
11. a.	30	110				8	4	1	5.5
b.	30	140				8	5		5.4
c.	30	130				8	4	1	5.5
12. a.	30	990		3	10				3.7
b.	30	1400		10	3				3.2
c.	30	1140	1	10	2				3.1
13. a.	30	300			4	9			4.7
b.	30	440		1	8	4			4.2
c.	30	350			7	6			4.5
14. a.	30	990		3	9	1			3.9
b.	30	1400		7	5	1			3.5
c.	30	1140		10	3				3.2

(1) - (4) See Table 12 for explanation

TABLE 12B. SERIES 16 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Proportional
Date: November 16, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run	Load	Dilution	Burnt-Smoky "B" Standard				
No.	HP	Ratio	0	1	2	3	Average
1. a. (1)	30(4)	110		1	11	1	1.9
b. (2)	30	150		5	8		1.6
c. (3)	30	120		7	6		1.5
2. a.	30	110		1	12		1.9
b.	30	150		6	7		1.5
c.	30	120		9	4		1.3
3. a.	30	300		12	1		1.1
b.	30	440	1	11	1		1.0
c.	30	350	2	10	1		0.9
4. a.	30	110		2	11		1.9
b.	30	140		6	7		1.5
c.	30	130		6	7		1.5
5. a.	30	990	1	12			0.9
b.	30	1400	3	10			0.8
c.	30	1140	6	7			0.5
6. a.	30	990	1	12			0.9
b.	30	1400	1	12			0.9
c.	30	1140	3	10			0.8
7. a.	30	300	1	5	7		1.5
b.	30	440	1	9	3		1.2
c.	30	350	1	9	3		1.2
8. a.	30	300		8	4	1	1.5
b.	30	440		9	4		1.3
c.	30	350	1	11	1		1.0
9. a.	30	110	1	1	6	5	2.2
b.	30	150		3	8	2	1.9
c.	30	120		4	4	5	2.1
10. a.	30	300	1	4	7	1	1.6
b.	30	440	1	9	3		1.2
c.	30	350		12	1		1.1
11. a.	30	110		6	6	1	1.6
b.	30	140		7	6		1.5
c.	30	130		7	5	1	1.5
12. a.	30	990	1	10	2		1.1
b.	30	1400	3	9	1		0.9
c.	30	1140	3	10			0.8
13. a.	30	300		10	3		1.2
b.	30	440		12	1		1.9
c.	30	350		11	2		1.2
14. a.	30	990	2	10	1		0.9
b.	30	1400	3	9	1		0.9
c.	30	1140	3	9	1		0.9

(1) - (4) See Table 12 for explanation.

TABLE 12C. SERIES 16 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695	Type Operation: Idle-Acceleration
Sample Method: Proportional	Vehicle Speed: 0-35 mph
Date: November 16, 1966	Fuel: Reference No. 1

Run	Load	Dilution	Oily "O" Standard				
No.	HP	Ratio	0	1	2	3	Average
1. a. (1)	30(4)	110	1	2	10		1.7
b. (2)	30	150	1	10	2		1.8
c. (3)	30	120	1	9	3		1.2
2. a.	30	110	1	3	9		1.6
b.	30	150	2	6	5		1.2
c.	30	120	2	8	3		1.1
3. a.	30	300	2	10	1		0.9
b.	30	440	2	11			0.9
c.	30	350	2	11			0.9
4. a.	30	110	1	5	7		1.5
b.	30	140	1	11	1		1.0
c.	30	130	1	10	2		1.1
5. a.	30	990	3	10			0.8
b.	30	1400	5	8			0.6
c.	30	1140	4	9			0.7
6. a.	30	990	4	9			0.7
b.	30	1400	4	9			0.7
c.	30	1140	3	10			0.8
7. a.	30	300	3	7	3		1.0
b.	30	440	3	8	2		0.9
c.	30	350	2	8	3		1.1
8. a.	30	300	2	8	3		1.1
b.	30	440	1	10	2		1.1
c.	30	350	1	11	1		1.0
9. a.	30	110	1	3	8	1	1.7
b.	30	150	1	5	7		1.5
c.	30	120	1	6	5	1	1.5
10. a.	30	300	2	10	1		0.9
b.	30	440	2	10	1		0.9
c.	30	350	2	11			0.9
11. a.	30	110	1	6	5	1	1.5
b.	30	140	1	8	5		1.2
c.	30	130	1	7	5		1.3
12. a.	30	990	5	6	2		0.8
b.	30	1400	4	9			0.7
c.	30	1140	4	9			0.7
13. a.	30	300	1	11	1		1.0
b.	30	440	1	12			0.9
c.	30	350	1	12			0.9
14. a.	30	990	4	9			0.7
b.	30	1400	6	7			0.5
c.	30	1140	6	7			0.5

(1) - (4) See Table 12 for explanation.

TABLE 12D. SERIES 16 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Proportional
Date: November 16, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	Aromatic "A" Standard 0	1	2	Average
1. a. (1)	30(4)	110	2	10	1	0.9
b. (2)	30	150		11	2	1.2
c. (3)	30	120	1	11	1	1.0
2. a.	30	110	2	9	2	1.0
b.	30	150		12	1	1.2
c.	30	120		11	2	1.2
3. a.	30	300	6	7		0.5
b.	30	440	8	5		0.4
c.	30	350	6	6	1	0.6
4. a.	30	110	1	11	1	1.0
b.	30	140	1	12		0.9
c.	30	130	1	12		0.9
5. a.	30	990	4	9		0.7
b.	30	1400	7	6		0.5
c.	30	1140	6	7		0.5
6. a.	30	990	5	8		0.6
b.	30	1400	4	9		0.7
c.	30	1140	6	7		0.5
7. a.	30	300	2	10	1	0.9
b.	30	440	4	9		0.7
c.	30	350	4	8	1	0.8
8. a.	30	300	3	10		0.8
b.	30	440	3	9	1	0.8
c.	30	350	5	7	1	0.7
9. a.	30	110		9	4	1.3
b.	30	150		8	5	1.4
c.	30	120	1	8	4	1.2
10. a.	30	300	1	11	1	1.0
b.	30	440	3	9	1	0.9
c.	30	350	3	9	1	0.9
11. a.	30	110	2	10	1	0.9
b.	30	140	2	10	1	0.9
c.	30	130	2	9	2	1.0
12. a.	30	990	6	7		0.5
b.	30	1400	6	7		0.5
c.	30	1140	6	7		0.5
13. a.	30	300	5	8		0.6
b.	30	440	6	7		0.5
c.	30	350	2	10	1	0.9
14. a.	30	990	4	9		0.7
b.	30	1400	4	9		0.7
c.	30	1140	5	8		0.6

(1) - (4) See Table 12 for explanation.

TABLE 12E. SERIES 16 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Proportional
Date: November 16, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: 0-35 mph
Fuel: Reference No. 1

Run No.	Load HP	Dilution Ratio	Pungent "P" Standard 0	1	2	Average
1. a. (1)	30(4)	110	7	6		0.5
b. (2)	30	150	9	4		0.3
c. (3)	30	120	8	5		0.4
2. a.	30	110	9	4		0.3
b.	30	150	11	2		0.2
c.	30	120	9	4		0.3
3. a.	30	300	11	2		0.2
b.	30	440	11	2		0.2
c.	30	350	12	1		0.1
4. a.	30	110	11	2		0.2
b.	30	140	11	2		0.2
c.	30	130	10	3		0.2
5. a.	30	990	11	2		0.2
b.	30	1400	11	2		0.2
c.	30	1140	12	1		0.1
6. a.	30	990	13			0
b.	30	1400	12	1		0.1
c.	30	1140	13			0
7. a.	30	300	12	1		0.1
b.	30	440	12	1		0.1
c.	30	350	11	2		0.2
8. a.	30	300	11	2		0.2
b.	30	440	10	3		0.2
c.	30	350	10	3		0.2
9. a.	30	110	4	8	1	0.8
b.	30	150	6	7		0.5
c.	30	120	5	8		0.8
10. a.	30	300	10	3		0.2
b.	30	440	12	1		0.1
c.	30	350	10	3		0.2
11. a.	30	110	7	6		0.5
b.	30	140	7	6		0.5
c.	30	130	7	6		0.5
12. a.	30	990	12	1		0.1
b.	30	1400	12	1		0.1
c.	30	1140	13			0
13. a.	30	300	8	5		0.4
b.	30	440	8	5		0.4
c.	30	350	7	6		0.5
14. a.	30	990	11	2		0.2
b.	30	1400	11	2		0.2
c.	30	1140	11	2		0.2

(1) - (4) See Table 12 for explanation.

TABLE 13. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(Bus 695 - Constant Speed-Deceleration)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
PROPORTIONAL SAMPLING																		
7. a(1)	110	40	40(4)	7	5	6.0	3	1	1.3	2	1	1.6	2	1	1.3	1	0	0.4
8. a.	110	40	40	7	5	6.1	3	1	1.1	2	0	1.4	2	0	1.3	1	0	0.7
15. a.	110	40	40	7	6	6.3	3	1	1.1	2	0	1.6	2	0	1.0	1	0	0.4
						6.1			1.2			1.5			1.2			0.5
7. b. (2)	170	40	40	6	5	5.5	2	1	1.8	2	1	1.4	2	1	1.3	1	0	0.3
8. b.	170	40	40	6	5	5.7	2	1	1.5	2	1	1.3	2	0	1.2	1	0	0.4
15. b.	170	40	40	6	5	5.8	2	1	1.1	2	0	1.4	2	0	1.0	1	0	0.2
						5.6			1.4			1.4			1.2			0.3
7. c.(3)	285	40	40	6	4	5.3	2	0	1.4	2	1	1.3	2	1	1.3	1	0	0.3
8. c.	285	40	40	6	4	4.8	3	1	1.3	2	1	1.2	2	0	0.8	1	0	0.3
15. c.	285	40	40	6	4	5.0	2	0	1.3	2	0	1.0	2	0	0.9	1	0	0.3
						5.0			1.4			1.2			1.0			0.3
5. a.	330	40	40	5	4	4.3	2	1	1.2	2	1	1.1	1	0	0.8	1	0	0.3
11. a.	330	40	40	5	3	4.0	1	0	0.9	1	1	1.0	2	0	0.7	1	0	0.2
17. a.	330	40	40	6	4	4.1	1	0	0.9	2	0	0.8	2	0	1.0	0	0	0
						4.2			1.0			1.0			0.8			0.2
5. b.	500	40	40	5	3	4.0	2	1	1.1	1	1	1.0	1	0	0.6	1	0	0.3
11. b.	500	40	40	5	3	3.8	1	0	0.9	1	0	0.8	1	0	0.6	1	0	0.3
17. b.	500	40	40	5	3	3.7	1	0	0.7	2	0	0.8	2	0	0.7	1	0	0.3
						3.8			0.9			0.9			0.6			0.3
5. c.	850	40	40	4	3	3.8	2	0	0.9	2	1	1.0	1	0	0.6	1	0	0.3
11. c.	850	40	40	4	2	3.4	1	0	0.8	2	1	1.0	2	0	0.5	1	0	0.3
17. c.	850	40	40	4	3	3.5	2	0	0.8	2	0	0.8	2	0	0.8	1	0	0.2
						3.6			0.9			1.0			0.7			0.3
1. a.	1050	40	40	5	4	4.2	2	1	1.3	1	1	1.0	1	0	0.8	0	0	0
2. a.	1050	40	40	5	2	3.5	1	0	0.9	2	0	1.0	1	0	0.5	1	0	0.2
13. a.	1050	40	40	4	3	3.3	2	0	1.0	2	0	1.0	1	0	0.5	1	0	0
						3.6			1.1			1.0			0.6			0.1

TABLE 13. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Bus 695 - Constant Speed-Deceleration)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
1. b.	1600	40	40	5	3	2.6	2	0	1.0	1	1	1.0	2	0	0.9	1	0	0.1
2. b.	1600	40	40	4	1	3.0	1	0	0.7	2	1	1.0	1	0	0.5	1	0	0.1
13. b.	1600	40	40	4	3	3.0	3	0	0.7	2	0	0.9	1	0	0.5	1	0	0
						2.9			0.9			1.0			0.7			0.1
1. c.	2650	40	40	4	2	3.3	2	0	1.0	1	0	0.9	1	0	0.7	1	0	0.4
2. c.	2650	40	40	4	1	2.5	1	0	0.6	1	0	0.7	1	0	0.6	1	0	0.2
13. c.	2650	40	40	5	3	3.2	3	0	0.9	2	0	0.9	1	0	0.5	1	0	0
						3.1			0.9			0.9			0.7			0.3
CONSTANT SAMPLING																		
4. a.	100	40	40	7	5	6.1	3	1	2.0	2	1	1.1	2	0	1.2	1	0	0.8
6. a.	100	40	40	7	6	6.3	3	1	2.0	2	1	1.8	2	0	1.3	2	0	0.6
14. a.	100	40	40	7	6	6.4	3	1	2.0	2	0	1.8	2	0	1.0	1	0	0.5
						6.3			2.1			1.5			1.1			0.6
4. b.	100	40	40	7	6	6.3	3	1	2.1	2	1	1.0	2	0	1.0	1	0	0.5
6. b.	100	40	40	7	5	5.9	3	1	2.1	2	1	1.5	2	0	1.1	2	0	0.8
14. b.	100	40	40	7	6	6.3	3	1	2.1	2	1	1.0	2	0	1.0	1	0	0.5
						6.2			2.1			1.2			1.1			0.6
4. c.	100	40	40	7	6	6.1	3	0	2.1	2	0	1.5	2	0	1.0	1	0	0.8
6. c.	100	40	40	7	4	5.5	3	1	1.7	2	1	1.4	2	0	0.9	2	0	0.8
14. c.	100	40	40	8	6	6.5	2	1	1.0	2	1	1.7	2	0	1.9	1	0	0.8
						6.1			1.7			1.6			1.0			0.8
10. a.	300	40	40	5	4	4.7	2	0	1.0	1	1	1.0	2	0	1.0	1	0	0.3
12. a.	300	40	40	5	3	4.3	2	0	1.1	1	0	0.9	1	0	0.8	1	0	0.2
18. a.	300	40	40	5	4	4.7	2	1	1.3	1	1	1.0	1	0	0.8	1	0	0.8
						4.6			1.0			1.0			0.9			0.2
10. b.	300	40	40	6	4	4.9	2	0	0.9	1	0	0.9	2	0	0.9	1	0	0.4
12. b.	300	40	40	5	4	4.8	2	0	1.0	1	0	0.9	1	0	0.6	1	0	0.3
18. b.	300	40	40	5	3	4.4	2	1	1.2	2	1	1.0	1	0	0.7	1	0	0.3
						4.7			1.1			1.0			0.8			0.3

TABLE 13. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 3

(Bus 695 - Constant Speed-Deceleration)

Run No	Dilution Ratio	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
10. c.	300	40	40	5	4	4.7	2	0	1.0	2	0	1.0	2	0	0.8	1	0	0.4
12. c.	300	40	40	6	4	4.3	2	0	1.1	2	0	0.9	2	0	0.8	1	0	0.4
18. c.	300	40	40	5	3	4.6	2	1	1.2	2	1	1.0	2	0	0.6	1	0	0.9
						4.5			1.1			1.0			0.8			0.6
3. a.	1000	40	40	5	3	4.1	2	1	1.2	2	1	1.1	1	0	0.8	1	0	0.3
9. a.	1000	40	40	4	3	3.8	1	1	1.0	1	0	1.2	1	0	0.6	1	0	0.4
16. a.	1000	40	40	5	3	3.7	2	0	1.1	2	0	1.0	1	0	0.5	1	0	0.2
						3.8			1.1			1.1			0.6			0.3
3. b.	1000	40	40	5	3	3.9	2	1	1.2	2	1	1.1	1	0	0.8	1	0	0.5
9. b.	1000	40	40	4	3	3.1	2	0	1.0	1	0	0.8	1	0	0.6	1	0	0.4
16. b.	1000	40	40	5	3	3.3	2	0	0.9	2	0	1.0	1	0	0.5	1	0	0.3
						3.4			1.0			0.9			0.6			0.4
3. c.	1000	40	40	5	4	4.3	2	1	1.3	2	1	1.2	2	0	0.9	1	0	0.9
9. c.	1000	40	40	3	2	2.9	2	0	0.9	2	0	0.8	1	0	0.9	1	0	0.5
16. c.	1000	40	40	4	2	3.0	2	0	0.8	1	0	0.9	2	0	0.6	1	0	0.4
						3.4			1.0			1.0			0.8			0.5

(1) "A" exposure is 5 seconds after closed rack deceleration following one minute at high speed and load

(2) "B" exposure is 25 seconds after closed rack deceleration following one minute at high speed and load

(3) "C" exposure is on downshift after closed rack deceleration following one minute at high speed and load

(4) Load at 40 mph for one minute, left in dynamometer during deceleration

TABLE 13A. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: See Below
Date: November 17, 1966
Type Operation: Constant Speed-Deceleration
Vehicle Speed: 40-0 mph
Fuel: Reference No. 1
Vehicle Load: 40 hp at 40 mph for 1 minute, left in dynamometer during deceleration

Run No.	Sample Method	Dilution Ratio	"D" Composite Responses							
			1	2	3	4	5	6	7	Average
1. a. (1)	Proportional	1050				9	2			4.2
b. (2)		1600			6	4	1			2.6
c. (3)		2650		1	9	2				3.4
2. a.	Proportional	1050		1	5	5	1			3.5
b.		1600	1	1	7	3				3.0
c.		2650	1	2	6	2				2.6
3. a.	Constant	1000			2	7	3			4.1
b.		1000			3	7	2			3.9
c.		1000				8	4			4.3
4. a.	Constant	100					1	9	2	6.1
b.		100					1	10	1	6.0
c.		100						10	2	6.2
5. a.	Proportional	330				7	5			4.3
b.		500			3	6	3			4.0
c.		850			3	9				3.8
6. a.	Constant	100						9	3	6.3
b.		100					4	5	3	5.9
c.		100				1	4	6	1	5.6
7. a.	Proportional	110					2	8	2	6.0
b.		170					5	7		5.5
c.		285				1	7	4		5.3
8. a.	Proportional	110					1	9	2	6.1
b.		170					4	8		5.7
c.		285				3	8	1		4.8
9. a.	Constant	1000			7	6				3.8
b.		1000			11	1				3.1
c.		1000		1	11					2.9
10. a.	Constant	300				3	9			4.8
b.		300				3	7	2		4.9
c.		300				8	4			4.7
11. a.	Proportional	330			3	6	3			4.0
b.		500			4	7	1			3.8
c.		850		1	5	6				3.4

TABLE 13A. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Diesel Composite "D" Standard)

Run No.	Sample Method	Dilution Ratio	"D" Composite Responses								
			1	2	3	4	5	6	7	8	Ave.
12. a.	Constant	300			1	6	5				4.3
b.		300				7	6				4.8
c.		300				4	6	1			4.3
13. a.	Proportional	1050			9	3					3.3
b.		1600			11	1					3.1
c.		2650			10	1	1				3.3
14. a.	Constant	100						7	5		6.4
b.		100						8	4		6.3
c.		100						7	4	1	6.5
15. a.	Proportional	110						9	3		6.3
b.		170					3	9			5.8
c.		285				2	8	2			5.0
16. a.	Constant	1000			6	4	2				3.7
b.		1000			10	1	1				3.3
c.		1000		1	10	1					3.0
17. a.	Proportional	330				11		1			4.2
b.		500			5	6	1				3.7
c.		850			6	6					3.5
18. a.	Constant	300				3	9				4.8
b.		300			1	5	6				4.4
c.		300			2	1	9				4.6

(1) - (3) See Table 13 for explanation.

TABLE 13B. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS

(Burnt-Smoky "B" Standards)

Vehicle: Bus 695	Type Operation: Constant speed-Deceleration
Sample Method: See Below	Vehicle Speed: 40-0 mph
Date: November 17, 1966	Fuel: Reference No. 1

Vehicle Load: 40 hp at 40 mph for 1 minute, left in dynamometer during deceleration

Run No.	Sample Method	Dilution Ratio	"B" Standards Responses 0	1	2	3	Ave.
1. a. (1)	Proportional	1050		8	3		1.3
b. (2)		1600	1	8	2		1.1
c. (3)		2650	2	7	2		1.0
2. a.	Proportional	1050	1	11			0.9
b.		1600	3	9			0.8
c.		2650	4	8			0.7
3. a.	Constant	1000		10	2		1.2
b.		1000		10	2		1.2
c.		1000		8	4		1.3
4. a.	Constant	100		1	9	2	2.1
b.		100		1	9	2	2.1
c.		100	1		7	4	2.2
5. a.	Proportional	330		10	2		1.2
b.		500		11	1		1.1
c.		850	1	10	1		0.9
6. a.	Constant	100		2	8	2	2.0
b.		100		1	9	2	2.1
c.		100		4	7	1	1.8
7. a.	Proportional	110		1	10	1	1.3
b.		170		3	9		1.8
c.		285	1	5	6		1.4
8. a.	Proportional	110		4	5	2	1.1
b.		170		6	6		1.5
c.		285		9	2	1	1.3
9. a.	Constant	1000		12			1.0
b.		1000	1	10	1		1.0
c.		1000	2	9	1		0.9
10. a.	Constant	300	1	10	1		1.0
b.		300	2	9	1		0.9
c.		300	1	10	1		1.0
11. a.	Proportional	330	1	11			0.9
b.		500	1	11			0.9
c.		850	2	10			0.8
12. a.	Constant	300	1	9	2		1.1
b.		300	1	9	2		1.1
c.		300	1	9	2		1.1

TABLE 13B. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS Page 2

(Burnt-Smoky "B" Standards)

Run No.	Sample Method	Dilution Ratio	"B" Standards Responses 0	1	2	3	Averag
13. a.	Proportional	1050	1	10	1		1.0
b.		1600	5	6		1	0.8
c.		2600	4	6	1	1	0.9
14. a.	Constant	100		1	7	4	2.1
b.		100		1	9	2	2.1
c.		100		1	11		1.1
15. a.	Proportional	110		2	9	1	1.1
b.		170		4	8		1.1
c.		285	2	4	6		1.3
16. a.	Constant	1000	1	9	2		1.1
b.		1000	3	7	2		0.9
c.		1000	3	8	1		0.8
17. a.	Proportional	330	1	11			0.9
b.		500	3	9			0.8
c.		850	3	8	1		0.8
18. a.	Constant	300		9	3		1.3
b.		300		10	2		1.2
c.		300		10	2		1.2

(1) - (3) See Table 13 for explanation.

TABLE 13C. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: See Below
Date: November 17, 1966
Type Operation: Constant Speed-Deceleration
Vehicle Speed: 40-0 mph
Fuel: Reference No. 1
Vehicle Load: 40 hp at 40 mph for 1 minute, left in dynamometer during deceleration

Run No.	Sample Method	Dilution Ratio	"O" Standards Responses			
			0	1	2	Average
1. a. (1)	Proportional	1050		11		1. 0
b. (2)		1600		11		1. 0
c. (3)		2650	1	10		0. 9
2. a.	Proportional	1050	1	10	1	1. 0
b.		1600		11	1	1. 1
c.		2650	3	9		0. 8
3. a.	Constant	1000		11	1	1. 1
b.		1000		11	1	1. 1
c.		1000		10	2	1. 2
4. a.	Constant	100		4	8	1. 1
b.		100	1	3	8	1. 6
c.		100	1	4	7	1. 5
5. a.	Proportional	330		11	1	1. 1
b.		500		12		1. 0
c.		850		11	1	1. 1
6. a.	Constant	100		3	9	1. 8
b.		100		6	6	1. 5
c.		100		7	5	1. 4
7. a.	Proportional	110		5	7	1. 6
b.		170		7	5	1. 4
c.		285		8	4	1. 3
8. a.	Proportional	110	1	5	6	1. 4
b.		170		8	4	1. 3
c.		285		10	2	1. 2
9. a.	Constant	1000		11		1. 2
b.		1000	3	9		0. 8
c.		1000	3	8	1	0. 8
10. a.	Constant	300		12		1. 0
b.		300	1	11		0. 9
c.		300	1	10	1	1. 0
11. a.	Proportional	330		12		1. 0
b.		500	2	10		0. 8
c.		850		11	1	1. 1

TABLE 13C. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Oily "O" Standard)

Run No.	Sample Method	Dilution Ratio	"O" Standards Responses			
			0	1	2	Average
12. a.	Constant	300	1	11		0.9
b.		300	1	11		0.9
c.		300	2	9	1	0.9
13. a.	Proportional	1050	1	10	1	1.0
b.		1600	2	9	1	0.9
c.		2650	2	9	1	0.9
14. a.	Constant	100		3	9	1.8
b.		100		4	8	1.1
c.		100		3	9	1.8
15. a.	Proportional	110	1	3	8	1.6
b.		170	1	5	6	1.4
c.		285	1	9	2	1.1
16. a.	Constant	1000	1	10	1	1.0
b.		1000	1	10	1	1.0
c.		1000	1	11		0.9
17. a.	Proportional	330	3	8	1	0.8
b.		500	3	8	1	0.8
c.		850	3	8	1	0.8
18. a.	Constant	300		12		1.0
b.		300		10	2	1.0
c.		300		11	1	1.1

(1) - (3) See Table 13 for explanation.

TABLE 13D. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695	Type Operation: Constant Speed-Deceleration
Sample Method: See Below	Vehicle Speed: 40-0 mph
Date: November 17, 1966	Fuel: Reference No. 1

Vehicle Load: 40 hp at 40 mph for 1 minute, left in dynamometer during deceleration

Run No.	Sample Method	Dilution Ratio	"A" Standards Responses			
			0	1	2	Average
1. a. (1)	Proportional	1050	2	9		0.8
b. (2)		1600	2	8	1	0.9
c. (3)		2650	3	8		0.7
2. a.	Proportional	1050	6	6		0.5
b.		1600	5	7		0.5
c.		2650	4	8		0.7
3. a.	Constant	1000	3	9		0.8
b.		1000	3	9		0.8
c.		1000	2	9	1	0.9
4. a.	Constant	100	1	8	3	1.2
b.		100	1	9	2	1.1
c.		100	3	6	3	1.0
5. a.	Proportional	330	2	10		0.8
b.		500	5	7		0.6
c.		850	4	8		0.7
6. a.	Constant	100	1	7	4	1.3
b.		100	2	6	4	1.2
c.		100	3	7	2	0.9
7. a.	Proportional	110		8	4	1.3
b.		170		9	3	1.3
c.		285		9	3	1.3
8. a.	Proportional	110	2	5	5	1.3
b.		170	1	8	3	1.2
c.		285	3	8	1	0.8
9. a.	Constant	1000	5	7		0.6
b.		1000	5	7		0.6
c.		1000	3	9		0.8
10. a.	Constant	300	2	7	3	1.1
b.		300	3	7	2	0.9
c.		300	3	8	1	0.8
11. a.	Proportional	330	5	6	1	0.7
b.		500	6	6		0.5
c.		850	6	5	1	0.6

TABLE 13D. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Aromatic "A" Standard)

Run No.	Sample Method	Dilution Ratio	"A" Standards Responses 0	1	2	Average
12. a.	Constant	300	3	9		0.8
b.		300	4	8		0.7
c.		300	3	8	1	0.8
13. a.	Proportional	1050	5	7		0.6
b.		1600	6	6		0.5
c.		2650	5	7		0.6
14. a.	Constant	100	1	10	1	1.0
b.		100	1	10	1	1.0
c.		100	2	7	3	1.1
15. a.	Proportional	110	2	8	2	1.0
b.		170	1	9	2	1.1
c.		285	2	9	1	0.9
16. a.	Constant	1000	5	7		0.6
b.		1000	8	4		0.3
c.		1000	6	5	1	0.6
17. a.	Proportional	330	4	4	4	1.0
b.		500	4	7	1	0.8
c.		850	3	8	1	0.8
18. a.	Constant	300	3	9		0.8
b.		300	4	8		0.7
c.		300	6	5	1	0.6

(1) - (3) See Table 13 for explanation.

TABLE 13E. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standards)

Vehicle: Bus 695	Type Operation: Constant Speed-Deceleration
Sample Method: See Below	Vehicle Speed: 40-0 mph
Date: November 17, 1966	Fuel: Reference No. 1

Vehicle Load: 40 hp at 40 mph for 1 minute, left in dynamometer during deceleration

Run No.	Sample Method	Dilution Ratio	"P" Standards Responses 0	1	2	Average
1. a. (1)	Proportional	1050	11			0
b. (2)		1600	9	2		0.2
c. (3)		2650	6	5		0.5
2. a.	Proportional	1050	10	2		0.2
b.		1600	10	2		0.2
c.		2650	9	3		0.3
3. a.	Constant	1000	8	4		0.3
b.		1000	6	6		0.5
c.		1000	3	9		0.8
4. a.	Constant	100	3	9		0.8
b.		100	4	8		0.7
c.		100	2	10		0.8
5. a.	Proportional	330	8	4		0.3
b.		500	9	3		0.3
c.		850	8	4		0.3
6. a.	Constant	100	6	5	1	0.6
b.		100	5	6	1	0.7
c.		100	3	8	1	0.8
7. a.	Proportional	110	7	5		0.4
b.		170	9	3		0.3
c.		285	8	4		0.3
8. a.	Proportional	110	4	8		0.7
b.		170	7	5		0.4
c.		285	8	4		0.3
9. a.	Constant	1000	9	3		0.3
b.		1000	7	5		0.4
c.		1000	6	6		0.5
10. a.	Constant	300	9	3		0.3
b.		300	7	5		0.4
c.		300	7	5		0.4
11. a.	Proportional	330	9	3		0.3
b.		500	9	3		0.3
c.		850	8	4		0.2

TABLE 13E. SERIES 17 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Pungent "P" Standards)

Run No.	Sample Method	Dilution Ratio	"P" Standards Responses			
			0	1	2	Ave.
12. a.	Constant	300	9	3		0.3
b.		300	9	3		0.3
c.		300	7	5		0.4
13. a.	Proportional	1050	11	1		0.1
b.		1600	11	1		0.1
c.		2650	11	1		0.1
14. a.	Constant	100	6	6		0.5
b.		100	6	6		0.5
c.		100	3	9		0.8
15. a.	Proportional	110	7	5		0.3
b.		170	9	3		0.3
c.		285	8	4		0.3
16. a.	Constant	1000	10	2		0.2
b.		1000	10	2		0.2
c.		1000	9	3		0.3
17. a.	Proportional	330	12			0
b.		500	9	3		0.3
c.		850	9	3		0.3
18. a.	Constant	300	10	2		0.2
b.		300	9	3		0.3
c.		300	1	11		0.9

(1) - (9) See Table 13 for explanation.

TABLE 14. SERIES 18 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Mixed Conditions)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
CONSTANT SPEED																		
1.	100	20	40	6	5	5.6	3	1	1.8	2	1	1.6	2	0	0.9	1	0	0.3
16.	100	20	40	7	5	6.3	3	1	2.1	2	1	1.4	2	0	1.2	1	0	0.9
						6.0			2.0			1.5			1.1			0.6
2.	100	30	40	7	5	5.7	3	1	1.9	2	1	1.4	2	0	1.1	1	0	0.3
20.	100	30	40	7	5	6.2	3	1	2.0	3	1	1.5	2	0	1.0	1	0	0.9
						6.0			2.0			1.5			1.1			0.6
7.	100	40	40	7	6	6.6	3	1	1.8	3	1	1.6	2	0	1.4	1	0	0.4
13.	300	20	40	6	4	4.9	3	1	1.6	2	1	1.3	2	0	0.9	1	0	0.3
10.	300	30	40	6	4	5.3	2	1	1.5	2	1	1.3	2	0	0.9	1	0	0.6
5.	300	40	40	7	5	5.4	3	1	1.7	2	1	1.2	1	0	0.8	1	0	0.2
17.	300	40	40	7	5	6.0	3	1	1.9	2	1	1.5	2	0	0.9	1	0	0.5
						5.7			1.8			1.4			0.9			0.4
8.	1000	20	40	5	3	4.5	2	1	1.2	2	1	1.2	1	0	0.6	0	0	0
12.	1000	20	40	5	4	4.4	3	1	1.3	2	1	1.1	1	0	0.7	1	0	0.2
						4.5			1.3			1.2			0.7			0.1
15.	1000	30	40	5	4	4.6	2	1	1.4	1	1	1.0	1	0	0.5	1	0	0.1
IDLE - ACCELERATION																		
14. a.	100	0-35	30(5)	7	6	6.6	3	2	2.4	2	1	1.9	2	1	1.3	1	0	0.8
18. a.	100	0-35	30	8	6	7.9	3	1	2.2	3	1	1.8	2	0	0.9	2	0	0.9
						6.8			2.3			1.9			1.1			0.9
14.b.	100	0-35	30	7	6	6.7	3	2	2.4	2	2	2.0	2	1	1.4	1	0	0.8
18.b.	100	0-35	30	7	4	6.2	3	1	2.0	2	1	1.6	2	0	1.1	2	0	1.0
						6.5			2.2			1.8			1.3			0.9
14. c.(4)	100	0-35	30	7	6	6.8	3	1	2.1	2	1	1.7	2	1	1.5	1	0	0.8
18. c.	100	0-35	30	7	6	6.6	3	1	2.8	2	1	1.6	2	0	1.1	2	0	0.8
						6.7			2.5			1.7			1.3			0.8

TABLE 14. SERIES 18 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Bus 695 - Mixed Conditions)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
IDLE - ACCELERATION (Continued)																		
3. a.	300	0-35	30	6	5	6.4	3	1	1.9	3	1	1.3	1	1	1.0	1	0	0.4
22. a.	300	0-35	30	6	4	5.5	2	1	1.2	2	0	1.1	2	0	0.9	1.0		0.4
						6.0			1.6			1.2			1.0			0.4
3. b.	300	0-35	30	6	4	5.4	2	1	1.6	2	1	1.3	1	1	1.0	1	0	0.4
22. b.	300	0-35	30	6	4	5.2	2	1	1.4	1	0	0.9	1	0	0.7	1	0	0.5
						5.3			1.5			1.1			0.9			0.5
3. c.	300	0-35	30	6	4	5.0	2	1	1.5	1	1	1.0	2	0	1.0	1	0	0.3
22. c.	300	0-35	30	6	4	5.3	2	1	1.2	2	0	1.0	2	0	0.9	1	0	0.6
						5.2			1.4			0.5			1.0			0.5
4. a.	1000	0-35	30	5	4	4.8	2	1	1.3	1	0	0.9	1	0	0.9	1	0	0.4
4. b.	1000	0-35	30	5	4	2.4	1	1	1.0	1	0	0.9	1	0	0.7	0	0	0
4. c.	1000	0-35	30	5	4	4.0	3	0	1.1	1	1	1.0	1	0	0.9	1	0	0.2
CONSTANT SPEED - DECELERATION																		
9. a.(6)	100	40-0	40(9)	7	6	6.3	3	1	2.0	2	1	1.7	2	0	1.1	1	0	0.6
21. a.	100	40-0	40	7	6	6.3	3	2	2.1	2	0	1.3	2	1	1.4	1	0	0.6
						6.3			2.1			1.5			1.3			0.6
9. b.(7)	100	40-0	40	7	6	6.3	3	2	2.1	2	1	1.6	2	0	1.2	2	0	0.6
21. b.	100	40-0	40	7	6	6.3	2	1	1.9	2	0	1.1	2	1	1.6	2	0	0.7
						6.3			2.0			1.4			1.4			0.7
9. c.(8)	100	40-0	40	7	6	6.6	3	2	2.2	2	1	1.6	2	1	1.3	1	1	1.0
21. c.	100	40-0	40	8	5	6.4	3	2	2.1	2	0	1.1	2	1	1.5	2	0	1.0
						6.5			2.2			1.4			1.4			1.0
6. a.	300	40-0	40	6	5	5.7	3	1	2.0	2	1	1.2	2	0	1.0	1	0	0.4
6. b.	300	40-0	40	7	5	6.0	2	1	1.8	2	1	1.3	2	0	1.1	1	0	0.5
6. c.	300	40-0	40	7	5	6.0	3	2	2.1	2	1	1.4	2	0	0.8	1	0	0.7

TABLE 14. SERIES 18 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 3

(Bus 695 - Mixed Conditions)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
11. a.	1000	40-0	40	5	4	4. 4	1	1	1. 0	1	0	0. 8	1	0	0. 9	1	0	0. 4
19. a.	1000	40-0	40	5	3	4. 3	2	1	1. 2	2	1	1. 1	1	0	0. 7	0	0	0
						4. 4			1. 1			1. 0			0. 8			0. 2
11. b.	1000	40-0	40	5	3	3. 8	1	0	0. 9	1	0	0. 8	1	0	0. 8	1	0	0. 3
19. b.	1000	40-0	40	5	3	4. 1	2	1	1. 2	1	0	0. 9	1	0	0. 7	1	0	0. 2
						4. 0			1. 1			0. 9			0. 8			0. 3
11. c.	1000	40-0	40	4	3	3. 4	1	0	0. 7	1	0	0. 8	1	0	0. 8	1	0	0. 4
19. c.	1000	40-0	40	5	3	4. 4	3	1	1. 5	1	0	0. 9	1	0	0. 7	1	0	0. 3
						3. 8			1. 1			0. 9			0. 8			0. 4

(1) Constant Sample

(2) "a" exposure is 3 seconds after start of open rack acceleration

(3) "b" exposure is 5 seconds after upshift

(4) "c" exposure is on reaching 35 mph

(5) Load is impressed at 30 mph and left in dynamometer throughout acceleration

(6) "a" exposure is 5 seconds after closed rack deceleration following one minute at high speed and load

(7) "b" exposure is 25 seconds after closed rack deceleration following one minute at high speed and load

(8) "c" exposure is on downshift (17 mph) after closed rack deceleration

(9) Load at 40 mph for 1 minute, left in dynamometer during deceleration

TABLE 14A. SERIES 18 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 18, 1966

Type Operation: Mixed Conditions

Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Response						
				3	4	5	6	7	8	Average
1.	20	40	100			4	6			5.6
2.	30	40	100			4	5	1		5.7
3. a.	0-35(2)	30(5)	300			3	7			6.4
b.	0-35(3)	30	300		1	4	5			5.4
c.	0-35(4)	30	300		2	6	2			5.0
4. a.	0-35	30	1000		2	8				4.8
b.	0-35	30	1000		6	4				2.4
c.	0-35	30	1000		8	2				4.2
5.	40	40	300			7	2	1		5.4
6. a.	40-0(6)	40(9)	300			3	7			5.7
b.	40-0(7)	40	300			2	6	2		6.0
c.	40-0(8)	40	300			2	6	2		6.0
7.	40	40	100				4	6		6.6
8.	20	40	1000	1	3	6				4.5
9. a.	40-0	40	100				7	3		6.3
b.	40-0	40	100				7	3		6.3
c.	40-0	40	100				4	6		6.6
10.	30	40	300		1	5	4			5.3
11. a.	40-0	40	1000		6	4				4.4
b.	40-0	40	1000	3	6	1				3.8
c.	40-0	40	1000	6	4					3.4
12.	20	40	1000		6	4				4.4
13.	20	40	300		4	3	3			4.9
14. a.	0-35	30	100				4	6		6.6
b.	0-35	30	100				3	7		6.7
c.	0-35	30	100				2	8		6.8
15.	30	40	1000		4	6				4.6
16.	20	40	100			1	5	4		6.3
17.	40	40	300			2	6	2		6.0
18. a.	0-35	30	100				1	8	1	7.0
b.	0-35	30	100		1		5	4		6.2
c.	0-35	30	100				4	6		6.6
19. a.	40-0	40	1000	1	5	4				4.3
b.	40-0	40	1000	2	5	3				4.1
c.	40-0	40	1000	1	4	5				4.4
20.	30	40	100			1	6	3		6.2
21. a.	40-0	40	100				7	3		6.3
b.	40-0	40	100				7	3		6.3
c.	40-0	40	100			1	6	1	2	6.4
22. a.	0-35	30	300		1	3	6			5.5
b.	0-35	30	300		2	4	4			5.2
c.	0-35	30	300		2	3	5			5.3

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(1) - (9) - See Table 14 for explanation

TABLE 14B. SERIES 18 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 18, 1966

Type Operation: Mixed Conditions

Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	Burnt-Smoky "B" Responses				
				0	1	2	3	Average
1.	20	40	100		3	6	1	1.8
2.	30	40	100		3	5	2	1.9
3. a.	0-35(2)	30(5)	300		2	7	1	1.9
b.	0-35(3)	30	300		4	6		1.6
c.	0-35(4)	30	300		5	5		1.5
4. a.	0-35	30	1000		7	3		1.3
b.	0-35	30	1000		10			1.0
c.	0-35	30	1000	1	8		1	1.1
5.	40	40	300		4	5	1	1.7
6. a.	40-0(6)	40(9)	300		1	8	1	2.0
b.	40-0(7)	40	300		2	8		1.8
c.	40-0(8)	40	300			9	1	2.1
7.	40	40	100		4	4	2	1.8
8.	20	40	1000		8	2		1.2
9. a.	40-0	40	100		1	8	1	2.0
b.	40-0	40	100			9	1	2.1
c.	40-0	40	100			8	2	2.2
10.	30	40	300		5	5		1.5
11. a.	40-0	40	1000		10			1.0
b.	40-0	40	1000	1	9			0.9
c.	40-0	40	1000	3	7			0.7
12.	20	40	1000		8	1	1	1.3
13.	20	40	300		6	2	2	1.6
14. a.	0-35	30	100			6	4	2.4
b.	0-35	30	100			6	4	2.4
c.	0-35	30	100		2	5	3	2.1
15.	30	40	1000		6	4		1.4
16.	20	40	100		2	5	3	2.1
17.	40	40	300		2	7	1	1.9
18. a.	0-35	30	100		1	6	3	2.2
b.	0-35	30	100		1	8	1	2.0
c.	0-35	30	100		3	6	1	2.8
19. a.	40-0	40	1000		8	2		1.2
b.	40-0	40	1000		8	2		1.2
c.	40-0	40	1000		7	1	2	1.5
20.	30	40	100		2	6	2	2.0
21. a.	40-0	40	100			9	1	2.1
b.	40-0	40	100		1	9		1.9
c.	40-0	40	100			9	1	2.1
22. a.	0-35	30	300		8	2		1.2
b.	0-35	30	300		6	4		1.4
c.	0-35	30	300		8	2		1.2

(1) - (9) See Table 14 for explanation.

TABLE 14C. SERIES 18 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 18, 1966

Type Operation: Mixed Condition

Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"O" Oily Responses 0	1	2	3	Average
1.	20	40	100		4	6		1.6
2.	30	40	100		6	4		1.4
3. a.	0-35(2)	30(5)	300		6	3	1	1.3
b.	0-35(3)	30	300		7	3		1.3
c.	0-35(4)	30	300		10			1.0
4. a.	0-35	30	1000	1	9			0.9
b.	0-35	30	1000	1	9			0.9
c.	0-35	30	1000		10			1.0
5.	40	40	300		8	2		1.2
6. a.	40-0(6)	40(9)	300		8	2		1.2
b.	40-0(7)	40	300		7	3		1.3
c.	40-0(8)	40	300		6	4		1.4
7.	40	40	1000		3	6	1	1.6
8.	20	40	1000		8	2		1.2
9. a.	40-0	40	100		3	7		1.7
b.	40-0	40	100		4	6		1.6
c.	40-0	40	100		4	6		1.6
10.	30	40	300		7	3		1.3
11. a.	40-0	40	1000	2	8			0.8
b.	40-0	40	1000	2	8			0.8
c.	40-0	40	1000	2	8			0.8
12.	20	40	1000		9	1		1.1
13.	20	40	300		7	3		1.3
14. a.	0-35	30	100		1	9		1.9
b.	0-35	30	100			10		2.0
c.	0-35	30	100		3	7		1.7
15.	30	40	1000		10			1.0
16.	20	40	100		6	4		1.4
17.	40	40	300		5	5		1.5
18. a.	0-35	30	100		4	4	2	1.8
b.	0-35	30	100		4	6		1.6
c.	0-35	30	100		4	6		1.6
19. a.	40-0	40	1000		9	1		1.1
b.	40-0	40	1000	1	9			0.9
c.	40-0	40	1000	1	9			0.9
20.	30	40	100		6	3	1	1.2
21. a.	40-0	40	100	1	5	4		1.3
b.	40-0	40	100	2	5	3		1.1
c.	40-0	40	100	2	5	3		1.1
22. a.	0-35	30	30	1	7	2		1.1
b.	0-35	30	30	1	9			0.9
c.	0-35	30	30	1	8	1		1.0

(1) - (9) See Table 14 for explanation

TABLE 14D. SERIES 18 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 18, 1966

Type Operation: Mixed Conditions

Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	Aromatic "A" Response 0	1	2	Average
1.	20	40	100	2	7	1	0.9
2.	30	40	100	1	7	2	1.1
3. a.	0-35(2)	30(5)	300		10		1.0
b.	0-35(3)	30	300		10		1.0
c.	0-35(4)	30	300	1	8	1	1.0
4. a.	0-35	30	1000	1	9		0.9
b.	0-35	30	1000	3	7		0.7
c.	0-35	30	1000	1	9		0.9
5.	40	40	300	2	8		0.8
6. a.	40-0(6)	40(9)	300	1	8	1	1.0
b.	40-0(7)	40	300	2	5	3	1.1
c.	40-0(8)	40	300	3	6	1	0.8
7.	40	40	100	1	4	5	1.4
8.	20	40	1000	4	6		0.6
9. a.	40-0	40	100		9	1	1.1
b.	40-0	40	100		9	1	1.1
c.	40-0	40	100		7	3	1.3
10.	30	40	1000	2	7	1	0.9
11. a.	40-0	40	1000	1	9		0.9
b.	40-0	40	1000	2	8		0.8
c.	40-0	40	1000	2	8		0.8
12.	20	40	1000	3	7		0.7
13.	20	40	300	2	7	1	0.9
14. a.	0-35	30	100		7	3	1.3
b.	0-35	30	100		6	4	1.4
c.	0-35	30	100		5	5	1.5
15.	30	40	1000	5	5		0.5
16.	20	40	100	1	6	3	1.2
17.	40	40	300	4	3	3	0.9
18. a.	0-35	30	100	4	3	3	0.9
b.	0-35	30	100	3	3	4	1.1
c.	0-35	30	100	3	3	4	1.1
19. a.	40-0	40	1000	3	7		0.7
b.	40-0	40	1000	3	7		0.7
c.	40-0	40	1000	3	7		0.7
20.	30	40	100	3	4	3	1.0
21. a.	40-0	40	100		6	4	1.4
b.	40-0	40	100		4	6	1.6
c.	40-0	40	100		5	5	1.5
22. a.	0-35	30	300	3	5	2	0.9
b.	0-35	30	300	3	7		0.7
c.	0-35	30	300	2	7	1	0.9

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(1) - (9) See Table 14 for explanation.

TABLE 14E. SERIES 18 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 18, 1966

Type Operation: Mixed Conditions
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	Pungent "P" Responses				
				0	1	2	3	Average
1.	20	40	100	7	3			0. 3
2.	30	40	100	7	3			0. 3
3. a.	0-35(2)	30(5)	300	6	4			0. 4
b.	0-35(3)	30	300	6	4			0. 4
c.	0-35(4)	30	300	7	3			0. 3
4. a.	0-35	30	1000	6	4			0. 4
b.	0-35	30	1000	10				0
c.	0-35	30	1000	8	2			0. 2
5.	40	40	300	3	7			0. 7
6. a.	40-0(6)	40(9)	300	5	4	1		0. 4
b.	40-0(7)	40	300	5	5			0. 5
c.	40-0(8)	40	300	3	7			0. 7
7.	40	40	1000	1	9			0. 9
8.	20	40	1000	10				0
9. a.	40-0	40	100	4	6			0. 6
b.	40-0	40	100	5	4	1		0. 6
c.	40-0	40	100		10			1. 0
10.	30	40	300	4	6			0. 6
11. a.	40-0	40	1000	6	4			0. 4
b.	40-0	40	1000	7	3			0. 3
c.	40-0	40	1000	6	4			0. 4
12.	20	40	1000	8	2			0. 2
13.	20	40	1000	7	3			0. 3
14. a.	0-35	30	100	2	8			0. 8
b.	0-35	30	100	2	8			0. 8
c.	0-35	30	100	2	8			0. 1
15.	30	40	1000	9	1			0. 9
16.	20	40	100	1	9			0. 5
17.	40	40	300	5	5			0. 9
18. a.	0-35	30	100	2	7	1		1. 0
b.	0-35	30	100	2	6	2		0. 8
c.	0-35	30	100	3	6	1		0. 8
19. a.	40-0	40	1000		9	1		1. 1
b.	40-0	40	1000	1	9			0. 9
c.	40-0	40	1000	1	9			0. 9
20.	30	40	100		6	3	1	1. 2
21. a.	40-0	40	100	1	5	4		1. 3
b.	40-0	40	100	2	5	3		1. 1
c.	40-0	40	100	2	5	3		1. 1
22. a.	0-35	30	30	1	7	2		1. 1
b.	0-35	30	30	1	9			0. 9
c.	0-35	30	30	1	8	1		1. 0

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(1) - (9) See Table 14 for explanation.

TABLE 15. SERIES 19 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Mixed Conditions)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
CONSTANT SPEED																		
2.	100	20	40	7	6	6.5	3	2	2.4	3	2	2.1	2	0	1.0	1	0	0.5
6.	100	20	40	6	6	6.0	2	2	1.0	2	1	1.8	2	0	1.0	1	0	0.6
15.	100	20	40	7	6	6.5	3	2	2.2	2	1	1.8	2	0	0.9	1	0	0.6
						6.3			1.9			1.9			1.0			0.6
18.	100	30	40	8	6	7.0	3	2	2.4	2	1	1.9	2	1	1.3	1	0	0.5
12.	100	40	40	7	6	6.7	3	2	1.3	2	1	1.9	2	1	1.3	1	0	0.8
8.	300	20	40	5	3	4.1	1	0	0.8	1	1	1.0	1	0	0.7	0	0	0
10.	300	30	40	5	4	4.1	2	0	1.1	1	0	0.8	1	0	0.5	1	0	0.3
4.	300	40	40	7	5	5.8	2	1	1.7	2	1	1.5	2	0	1.3	1	0	0.2
14.	1000	20	40	5	4	4.3	2	1	1.2	1	0	0.9	2	0	1.1	1	0	1.1
1.	1000	30	40	6	4	5.0	2	1	1.2	2	1	1.1	1	0	0.6	0	0	0
9.	1000	40	40	5	3	4.3	1	0	0.7	1	0	0.9	1	0	0.6	1	0	0.1
IDLE - ACCELERATION																		
3. a.(2)	100	0-35	30(5)	7	6	6.4	3	2	2.4	2	1	1.9	2	0	1.1	1	0	0.7
16. a.	100	0-35	30	7	7	7.0	3	2	2.6	2	2	2.0	2	0	1.4	1	0	0.9
						6.8			2.5			1.9			1.3			0.8
3.b.(3)	100	0-35	30	7	6	6.8	3	2	2.4	3	1	2.0	2	0	1.1	1	1	1.0
16.b.	100	0-35	30	7	6	6.9	3	2	2.2	2	1	1.8	2	0	1.6	1	1	1.0
						6.9			2.3			1.9			1.4			1.0
3. c.(4)	100	0-35	30	7	6	6.9	3	2	2.6	3	1	2.0	2	0	1.3	1	0	1.0
16. c.	100	0-35	30	7	6	6.8	3	2	2.5	2	1	1.7	2	0	1.6	1	0	0.7
						6.9			2.6			1.9			1.5			0.9
17. a.	1000	0-35	30	5	4	4.3	2	0	1.0	1	0	0.9	1	0	0.3	1	0	0.3
17. b.	1000	0-35	30	4	3	3.9	1	0	0.9	1	0	0.8	1	0	0.8	1	0	0.2
17. c.	1000	0-35	30	4	3	3.5	1	0	0.7	1	0	0.8	1	0	0.8	1	0	0.3

TABLE 15. SERIES 19 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Bux 695 - Mixed Conditions)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"F" Pungent Max.	"F" Pungent Min.	"F" Pungent Ave.
CONSTANT SPEED - DECELERATION																		
13. a.(6)	100	40-0	40(9)	7	6	6. 2	3	2	2. 1	2	0	1. 8	2	0	1. 2	1	0	0. 5
13. b.(7)	100	40-0	40	7	6	6. 2	3	1	2. 0	3	1	1. 5	2	0	1. 3	1	0	0. 6
13. c.(8)	100	40-0	40	7	6	6. 5	3	2	2. 0	2	1	1. 8	2	1	1. 5	1	0	1. 1
7. a.	300	40-0	40	6	5	5. 8	2	0	1. 1	2	0	1. 1	2	0	1. 3	1	0	0. 7
7. b.	300	40-0	40	6	4	5. 1	2	0	1. 1	1	0	0. 9	2	0	1. 1	1	0	0. 7
7. c.	300	40-0	40	7	4	5. 2	2	0	1. 1	2	1	1. 1	2	0	1. 3	1	0	0. 7
5. a.	1000	40-0	40	6	4	4. 5	2	1	1. 3	2	1	1. 2	1	0	0. 9	1	0	0. 1
11. a.	1000	40-0	40	5	4	4. 2	2	0	0. 9	1	0	0. 8	2	0	1. 0	1	0	0. 2
						4. 4			1. 1			1. 0			1. 0			0. 2
5. b.	1000	40-0	40	6	3	4. 2	2	1	1. 2	2	0	1. 0	2	0	0. 8	1	0	. 1
11. b.	1000	40-0	40	5	3	3. 9	1	0	0. 9	1	0	0. 8	2	0	0. 8	1	0	0. 2
						4. 1			1. 1			0. 9			0. 8			0. 2
5. c.	1000	40-0	40	6	3	3. 9	2	1	1. 1	2	0	1. 0	2	0	0. 8	1	0	0. 2
11. c.	1000	40-0	40	4	3	3. 8	1	0	0. 8	1	0	0. 8	2	0	0. 8	1	0	0. 3
						3. 9			1. 0			0. 9			0. 8			0. 3

(1) Constant Sample
(2) "a" exposure is 3 seconds after start of open rack acceleration
(3) "b" exposure is 5 seconds after upshift
(4) "c" exposure is on reaching 35 mph
(5) Load is impressed at 30 mph and left in dynamometer throughout acceleration
(6) "a" exposure is 5 seconds after closed rack deceleration following one minute at high speed and load
(7) "b" exposure is 25 seconds after closed rack deceleration following one minute at high speed and load
(8) "c" exposure is on downshift (17 mph) after closed rack deceleration
(9) Load at 40 mph for 1 minute, left in dynamometer during deceleration

TABLE 15A. SERIES 19 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 22, 1966

Type Operation: Mixed Conditions

Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Responses						
				3	4	5	6	7	8	Average
1.	30	40	1000		2	6	2			5.0
2.	20	40	100				5	5		6.5
3. a.	0-35(2)	30(5)	100				6	4		6.4
b.	0-35(3)	30	100				2	8		6.8
c.	0-35(4)	30	100				2	7	1	6.9
4.	40	40	300			3	6	1		5.8
5. a.	40-0(6)	40(9)	1000		6	3	1			4.5
b.	40-0(7)	40	1000	1	7	1	1			4.2
c.	40-0(8)	40	1000	3	6			1		3.9
6.	20	40	100				10			6.0
7. a.	40-0	40	300			6	4			5.8
b.	40-0	40	300		2	5	3			5.1
c.	40-0	40	300		2	5	2	1		5.2
8.	20	40	300	2	5	3				4.1
9.	40	40	1000	2	3	5				4.3
10.	30	40	300		9	1				4.1
11. a.	40-0	40	1000		8	2				4.2
b.	40-0	40	1000	2	7	1				3.9
c.	40-0	40	1000	2	8					3.8
12.	40	40	100				3	7		6.7
13. a.	40-0	40	100				8	2		6.2
b.	40-0	40	100				8	2		6.2
c.	40-0	40	100				5	5		6.5
14.	20	40	1000		7	3				4.3
15.	20	40	100				5	5		6.5
16. a.	0-35	30	100					10		7.0
b.	0-35	30	100				1	9		6.9
c.	0-35	30	100				2	8		6.8
17. a.	0-35	30	1000		7	3				4.3
b.	0-35	30	1000	1	9					3.9
c.	0-35	30	1000	5	5					3.5
18.	30	40	100				2	6	2	7.0

(1) - (9) See Table 15 for explanation.

TABLE 15B. SERIES 19 PROCEDURAL DEVELOPMENT RESULTS

(Burnt-smoky "B" Standard)

Vehicle: Bus 695

Type Operation: Mixed Conditions

Sample Method: Constant

Date: November 22, 1966

Fuel: Reference No. 1

Run	Speed	Load	Dilution	"B" Burnt-Smoky Responses				
No:	MPH	HP	Ratio(1)	0	1	2	3	Ave.
1.	30	40	1000		8	2		1.2
2.	20	40	100			6	4	2.4
3. a.	0-35(2)	30(5)	100			6	4	2.4
b.	0-35(3)	30	100			6	4	2.4
c.	0-35(4)	30	100			4	6	2.6
4.	40	40	300		3	7		1.7
5. a.	40-0(6)	40(9)	1000		7	3		1.3
b.	40-0(7)	40	1000		8	2		1.2
c.	40-0(8)	40	1000		9	1		1.0
6.	20	40	100			10		2.0
7. a.	40-0	40	300	1	7	2		1.1
b.	40-0	40	300	1	7	2		1.1
c.	40-0	40	300	1	7	2		1.1
8.	20	40	300	2	8			0.8
9.	40	40	1000	3	7			0.7
10.	30	40	300	1	7	2		1.1
11. a.	40-0	40	1000	2	7	1		0.9
b.	40-0	40	1000	1	9			0.9
c.	40-0	40	1000	2	8			0.8
12.	40	40	100			7	3	1.3
13. a.	40-0	40	100			9	1	2.1
b.	40-0	40	100		1	7	2	2.0
c.	40-0	40	100			7	3	2.0
14.	20	40	1000		8	2		1.2
15.	20	40	100			8	2	2.2
16. a.	0-35	30	100			4	6	2.6
b.	0-35	30	100			8	2	2.2
c.	0-35	30	100			5	5	2.5
17. a.	0-35	30	1000	2	8	1		1.0
b.	0-35	30	1000	1	9			0.9
c.	0-35	30	1000	3	7			0.7
18.	30	40	100			6	4	2.4

(1) - (9) See Table 15 for explanation.

TABLE 15C. SERIES 19 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 22, 1966

Type Operation: Mixed Conditions

Fuel: Reference No. 1

Run	Speed	Load	Dilution	"O" Oily Responses				
No	MPH	HP	Ratio(1)	0	1	2	3	Average
1.	30	40	1000		9	1		1.1
2.	20	40	100			9	1	2.1
3. a.	0-35(2)	30(5)	100		1	9		1.9
b.	0-35(3)	30	100		1	8	1	2.0
c.	0-35(4)	30	100		1	8	1	2.0
4.	40	40	300		5	5		1.5
5. a.	40-0(6)	40(9)	1000		8	2		1.2
b.	40-0(7)	40	1000	1	8	1		1.0
c.	40-0(8)	40	1000	1	8	1		1.0
6.	20	40	100		2	8		1.8
7. a.	40-0	40	300	1	7	2		1.1
b.	40-0	40	300	1	9			0.9
c.	40-0	40	300		9	1		1.1
8.	20	40	300		10			1.0
9.	40	40	1000	1	9			0.9
10.	30	40	300	2	8			0.8
11. a.	40-0	40	1000	2	8			0.8
b.	40-0	40	1000	2	8			0.8
c.	40-0	40	1000	2	8			0.8
12.	40	40	100		1	9		1.9
13. a.	40-0	40	100		2	8		1.8
b.	40-0	40	100		3	6	1	1.5
c.	40-0	40	100		2	8		1.8
14.	20	40	1000	1	9			0.9
15.	20	40	100		2	8		1.8
16. a.	0-35	30	100			10		2.0
b.	0-35	30	100		2	8		1.8
c.	0-35	30	100		3	7		1.7
17. a.	0-35	30	1000	1	9			0.9
b.	0-35	30	1000	2	8			0.8
c.	0-35	30	1000	2	8			0.8
18.	30	40	100		1	9		1.9

(1) - (9) See Table 15 for explanation.

TABLE 15D. SERIES 19 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic - "A" Standard)

Vehicle: Bus 695 — Type Operation: Mixed Conditions
Sample Method: Constant
Date: November 22, 1966 — Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio (1)	"A" Aromatic Responses 0	1	2	3	Average
1.	30	40	1000	4	6			0.6
2.	20	40	100	1	8	1		1.0
3. a.	0-35(2)	30(5)	100	1	7	2		1.1
b.	0-35(3)	30	100	2	6	2		1.1
c.	0-35(4)	30	100	1	5	4		1.3
4.	40	40	300	1	5	4		1.3
5. a.	40-0(6)	40(9)	1000	1	9			0.9
b.	40-0(7)	40	1000	3	6	1		0.8
c.	40-0(8)	40	1000	2	7	1		0.8
6.	20	40	100	2	6	2		1.0
7. a.	40-0	40	300	1	5	4		1.3
b.	40-0	40	300	2	5	3		1.1
c.	40-0	40	300		7	3		1.3
8.	20	40	300	3	7			0.7
9.	40	40	1000	4	6			0.6
10.	30	40	300	5	5			0.5
11. a.	40-0	40	1000	2	6	2		1.0
b.	40-0	40	1000	3	6	1		0.8
c.	40-0	40	1000	3	6	1		0.8
12.	40	40	100	1	7	3		1.3
13. a.	40-0	40	100	1	6	3		1.2
b.	40-0	40	100	1	5	4		1.3
c.	40-0	40	100		5	5		1.5
14.	20	40	1000	1	7	2		1.1
15.	20	40	100	2	7	1		0.9
16. a.	0-35	30	100	1	4	5		1.4
b.	0-35	30	100	1	2	7		1.6
c.	0-35	30	100	1	2	7		1.6
17. a.	0-35	30	1000	2	8			0.8
b.	0-35	30	1000	2	8			0.8
c.	0-35	30	1000	2	8			0.8
18.	30	40	100		7	3		1.3

(1) - (9) See Table 15 for explanation.

TABLE 15E. SERIES 19 PROCEDURE DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 22, 1966

Type Operation: Mixed Conditions

Fuel: Reference No. 1

Run	Speed	Load	Dilution	"P" Pungent Response		
No.	MPH	HP	Ratio (1)	0	1	Average
1.	30	40	1000	10		0
2.	20	40	100	5	5	0.5
3. a.	0-35(2)	30(5)	100	3	7	0.7
b.	0-35(3)	30	100		10	1.0
c.	0-35(4)	30	100	1	9	0.9
4.	40	40	300	8	2	0.2
5. a.	40-0(6)	40(9)	1000	9	1	0.1
b.	40-0(7)	40	1000	9	1	0.1
c.	40-0(8)	40	1000	8	2	0.2
6.	20	40	100	4	6	0.6
7. a.	40-0	40	300	3	7	0.7
b.	40-0	40	300	3	7	0.7
c.	40-0	40	300	3	7	0.7
8.	20	40	300	10		0
9.	40	40	1000	9	1	0.1
10.	30	40	300	7	3	0.3
11. a.	40-0	40	1000	8	2	0.2
b.	40-0	40	1000	8	2	0.2
c.	40-0	40	1000	7	3	0.3
12.	40	40	100	2	8	0.8
13. a.	40-0	40	100	5	5	0.5
b.	40-0	40	100	4	6	0.6
c.	40-0	40	100	3	7	0.7
14.	20	40	1000	8	2	0.2
15.	20	40	100	4	6	0.6
16. a.	0-35	30	100	1	9	0.9
b.	0-35	30	100		10	1.0
c.	0-35	30	100	3	7	0.7
17. a.	0-35	30	1000	7	3	0.3
b.	0-35	30	1000	8	2	0.2
c.	0-35	30	1000	7	3	0.3
18.	30	40	100	5	5	0.5

(1) - (9) See Table 15 for explanation.

TABLE 16. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Mixed Conditions)

Run No.	Dilution Ratio (l)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
CONSTANT SPEED																		
10.	100	20	40	7	6	6.3	3	2	2.1	3	1	1.9	2	1	1.3	1	0	0.8
18.	100	20	40	7	6	6.6	3	1	2.5	2	1	1.8	2	0	1.3	1	0	0.7
						6.5			2.3			1.9			1.3			0.8
14.	100	30	40	7	6	6.3	3	2	2.1	3	1	1.9	2	1	1.3	1	0	0.8
22.	100	30	40	7	6	6.1	3	2	2.2	2	0	1.6	1	0	0.9	1	0	0.7
						6.2			2.2			1.8			1.1			0.8
1.	100	40	40	7	5	5.6	3	1	1.9	2	1	1.4	1	0	0.7	1	0	0.4
11	100	40	40	7	7	7.0	3	1	2.4	3	1	1.9	2	0	1.5	1	0	0.9
24.	100	40	40	6	6	6.0	3	2	2.1	2	0	1.7	2	0	1.2	2	0	0.8
						6.2			2.1			1.7			1.1			0.7
4.	300	20	40	5	4	4.8	2	1	1.2	2	0	1.2	2	0	1.0	1	0	0.1
13.	300	30	40	5	4	4.6	2	1	1.2	2	0	1.0	1	0	0.7	1	0	0.2
16.	300	30	40	5	3	4.2	2	0	1.0	2	0	1.0	2	0	0.7	1	0	0.2
						4.4			1.1			1.0			0.7			0.2
5.	1000	20	40	4	4	4.0	2	1	1.2	2	0	1.0	1	0	0.7	0	0	0
12	1000	20	40	6	4	4.7	2	1	1.2	1	0	0.8	2	0	0.7	1	0	0.3
						4.4			1.2			0.9			0.7			0.2
7.	1000	30	40	4	3	3.7	2	0	1.0	2	0	0.9	1	0	0.7	1	0	0.2
9.	1000	30	40	5	3	3.8	2	0	1.0	2	0	1.1	1	0	0.7	1	0	0.3
21.	1000	30	40	6	4	4.8	2	1	1.5	2	0	1.1	1	0	0.7	1	0	0.1
						4.1			1.2			1.0			0.7			0.2
IDLE-ACCELERATION																		
3. a(2)	100	0-35	30(5)	7	6	6.5	3	2	2.3	2	2	2.0	2	1	1.3	1	0	0.8
23. a.	100	0-35		8	7	7.4	3	2	2.8	3	1	2.3	3	1	1.7	1	1	1.0
						7.0			2.6			2.2			1.5			0.9

TABLE 16. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2.
(Bus 695 - Mixed Conditions)

Run No.	Dilution Ratio (1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
IDLE-ACCELERATION - Cont.																		
3. b. (3)	100	0-35	30	7	5	5.2	3	1	2.0	3	1	1.9	2	1	1.4	1	0	0.8
23. b.	100	0-35	30	7	6	6.9	3	2	2.5	3	1	2.0	3	0	1.6	1	1	1.0
						6.1			2.3			2.0			1.5			0.9
3.c. (4)	100	0-35	30	7	4	6.0	2	1	1.8	2	1	1.6	2	1	1.4	1	0	0.7
23. c.	100	0-35	30	7	6	6.7	3	2	2.2	3	1	2.1	3	1	1.6	1	1	1.0
						6.4			2.0			1.9			1.5			0.9
15. a.	300	0-35	30	5	4	4.9	2	1	1.2	2	0	1.1	2	0	0.8	1	0	0.1
15. b.	300	0-35	30	5	4	4.8	2	1	1.2	2	0	1.0	2	0	0.9	1	0	0.2
15. c.	300	0-35	30	5	4	4.8	2	1	1.2	2	0	1.0	2	0	1.0	1	0	0.5
17. a.	1000	0-35	30	5	4	4.2	2	0	1.0	2	0	1.0	1	0	0.7	1	0	0.1
25. a	1000	0-35	30	6	4	5.0	2	1	1.5	2	1	1.5	1	0	0.7	1	0	0.4
						4.6			1.3			1.3			0.7			0.3
17. b.	1000	0-35	30	5	3	4.0	1	0	0.9	1	0	0.8	1	0	0.7	1	0	0.2
25. b.	1000	0-35	30	6	4	4.7	2	1	1.5	2	0	1.4	1	0	0.4	1	0	0.3
						4.4			1.2			1.1			0.6			0.3
17. c.	1000	0-35	30	5	3	4.0	1	1	1.0	1	0	0.8	1	0	0.7	1	0	0.1
25. c.	1000	0-35	30	5	3	4.1	2	1	1.1	2	0	0.9	1	0	0.4	1	0	0.2
						4.1			1.1			0.9			0.6			0.2
CONSTANT SPEED - DECELERATION																		
6.a. (6)	100	40-0	40(9)	7	6	6.2	3	2	2.2	2	1	1.7	2	1	1.5	1	0	0.8
19.a.	100	40-0	40	7	6	6.1	3	2	2.2	2	1	1.8	2	0	1.3	1	0	0.6
20.a.	100	40-0	40	6	5	5.7	2	1	1.8	2	1	1.6	2	1	1.2	1	0	0.6
						6.0			2.1			1.7			1.3			0.7
6.b. (7)	100	40-0	40	7	6	6.5	3	2	2.1	2	0	1.4	2	1	1.5	1	0	0.7
19.b.	100	40-0	40	7	6	6.1	2	2	2.0	2	1	1.7	2	0	1.3	1	0	0.6
20.b.	100	40-0	40	6	5	5.7	2	1	1.8	2	1	1.5	2	1	1.3	1	0	0.6
						6.1			2.0			1.5			2.1			0.6

TABLE 16. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS SUMMARYPage 3

(Bus 695 - Mixed Conditions)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
CONSTANT SPEED - DECELERATION (Cont.)																		
6.c.(8)	100	40-0	40	7	5	6.1	2	1	1.8	2	0	1.4	2	1	1.3	1	0	0.6
19.c.	100	40-0	40	7	7	7.0	3	2	2.5	2	1	1.7	2	0	1.5	2	0	1.0
20.c.	100	40-0	40	7	5	5.6	2	1	1.8	2	1	1.5	2	1	1.2	1	0	0.6
						6.2			2.0			1.5			1.3			0.7
8.a.	300	40-0	40	6	4	4.9	2	1	1.5	2	0	1.1	2	0	1.0	0	0	0
8.b.	300	40-0	40	5	4	4.5	2	0	1.3	1	0	0.9	2	0	0.7	1	0	0.2
8.c.	300	40-0	40	6	4	4.2	2	1	1.2	1	0	0.9	2	0	0.8	1	0	0.3
2.a.	1000	40-0	40	5	3	4.0	1	0	0.7	1	1	1.0	2	0	0.6	0	0	0
2.b.	1000	40-0	40	4	3	3.6	1	0	0.7	1	0	0.8	2	0	0.5	1	0	0.1
2.c.	1000	40-0	40	5	3	3.6	2	0	0.8	1	0	0.9	2	0	0.6	1	0	0.1

(1) Constant Sample

(2) "a" exposure 3 seconds after start of open rack acceleration

(3) "b" exposure is 5 seconds after upshift

(4) "c" exposure is on reaching 35 mph

(5) Load is impressed at 30 mph and left in dynamometer throughout acceleration.

(6) "a" exposure is 5 seconds after closed rack deceleration following one minute at high speed and load

(7) "b" exposure is 25 seconds after closed rack deceleration following 1 minute at high speed and load

(8) "c" exposure is on downshift (17 mph) after closed rack deceleration

(9) Load at 40 mph for 1 minute, left in dynamometer during deceleration

TABLE 16A. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 23, 1966

Type Operation: Mixed Conditions

Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Responses 3	4	5	6	7	8	Ave.
1.	40	40	100			5	4	1		5.6
2. a.	40-0(6)	40(9)	1000	1	8	1				4.0
b.	40-0(7)	40	1000	4	6					3.6
c.	40-0(8)	40	1000	5	4	1				3.6
3. a.	0-35(2)	30(5)	100				5	5		6.5
b.	0-35(3)	30	100			1	6	3		5.2
c.	0-35(4)	30	100		1	1	5	3		6.0
4.	20	40	300		2	8				4.8
5.	20	40	1000		10					4.0
6. a.	40-0	40	100				3	7		6.2
b.	40-0	40	100				5	5		6.5
c.	40-0	40	100			1	7	2		6.1
7.	30	40	1000	3	7					3.7
8. a.	40-0	40	300		2	7	1			4.9
b.	40-0	40	300		5	5				4.5
c.	40-0	40	300		4	5	1			4.2
9.	30	40	1000	3	6	1				3.8
10.	20	40	100				7	3		6.3
11.	40	40	100					10		7.0
12.	20	40	1000		4	5	1			4.7
13.	30	40	300		4	6				4.6
14.	30	40	100			1	5	4		6.3
15. a.	0-35	30	300		1	9				4.9
b.	0-35	30	300		2	8				4.8
c.	0-35	30	300		2	8				4.8
16.	30	40	300	1	6	3				4.2
17. a.	0-35	30	1000		8	2				4.2
b.	0-35	30	1000	3	4	3				4.0
c.	0-35	30	1000	2	6	2				4.0
18.	20	40	100				4	6		6.6
19. a.	40-0	40	100				9	1		6.1
b.	40-0	40	100				9	1		6.1
c.	40-0	40	100					10		7.0

Table 16A. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Diesel Composite "D" Standard)

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Responses 3	4	5	6	7	8	Ave.
20. a.	40-0	40	100			3	7			5.7
b.	40-0	40	100			3	7			5.7
c.	40-0	40	100			5	4	1		5.6
21.	30	40	1000		3	6	1			4.8
22.	30	40	100				9	1		6.1
23. a.	0-35	30	100					6	4	7.4
b.	0-35	30	100				1	9		6.9
c.	0-35	30	100				3	7		6.7
24.	40	40	100				10			6.0
25. a.	0-35	30	1000		1	8	1			5.0
b.	0-35	30	1000			4	5	1		4.7
c.	0-35	30	1000	1	7	2				4.1

(1) - (9) See Table 16 for explanation.

Table 16B. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 23, 1966

Type Operation: Mixed Conditions

Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"B" Standard Responses 0	1	2	3	Average
1.	40	40	100		2	7	1	1.9
2. a.	40-0(6)	40(9)	1000	3	7			0.7
b.	40-0(7)	40	1000	3	7			0.7
c.	40-0(8)	40	1000	3	6	1		0.8
3. a.	0-35(2)	30(5)	100			7	3	2.3
b.	0-35(3)	30	100		1	8	1	2.0
c.	0-35(4)	30	100		2	8		1.8
4.	20	40	300		8	2		1.2
5.	20	40	1000		8	2		1.2
6. a.	40-0	40	100			8	2	2.2
b.	40-0	40	100			9	1	2.1
c.	40-0	40	100		2	8		1.8
7.	30	40	1000	1	8	1		1.0
8. a.	40-0	40	300		5	5		1.5
b.	40-0	40	300	1	5	4		1.3
c.	40-0	40	300		8	2		1.2
9.	30	40	1000	1	8	1		1.0
10.	20	40	100			9	1	2.1
11.	40	40	100		1	4	5	2.4
12.	20	40	1000		8	2		1.2
13.	30	40	300		8	2		1.2
14.	30	40	100		4	3	3	1.9
15. a.	0-35	30	300		8	2		1.2
b.	0-35	30	300		8	2		1.2
c.	0-35	30	300		8	2		1.2
16.	30	40	300	1	8	1		1.0
17. a.	0-35	30	1000	1	8	1		1.0
b.	0-35	30	1000	1	9			0.9
c.	0-35	30	1000		10			1.0
18.	20	40	100		1	3	6	2.5
19. a.	40-0	40	100			8	2	2.2
b.	40-0	40	100			10		2.0
c.	40-0	40	100			5	5	2.5

Table 16B. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Burnt-Smoky "B" Standard)

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"B" Standard Responses 0	1	2	3	Ave.
20. a.	40-0	40	100		2	8		1. 8
b.	40-0	40	100		2	8		1. 8
c.	40-0	40	100		2	8		1. 8
21.	30	40	1000		5	5		1. 5
22.	30	40	100			8	2	2. 2
23. a.	0-35	30	100			2	8	2. 8
b.	0-35	30	100			5	5	2. 5
c.	0-35	30	100			8	2	2. 2
24.	40	40	100			9	1	2. 1
25. a.	0-35	30	1000		5	5		1. 5
b.	0-35	30	1000		5	5		1. 5
c.	0-35	30	1000		9	1		1. 1

(1) - (9) - See Table 16 for explanation.

TABLE 16C. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695 Type Operation: Mixed Conditions
Sample Method: Constant
Date: November 23, 1966 Fuel: Reference No. 1

Run	Speed	Load	Dilution		"O" Standard Responses			
No.	MPH	HP	Ratio(1)	0	1	2	3	Average
1.	40	40	100		6	4		1.4
2. a.	40-0(6)	40(9)	1000		10			1.0
b.	40-0(7)	40	1000	2	8			0.8
c.	40-0(8)	40	1000	1	9			0.9
3. a.	0-35(2)	30(5)	100			10		2.0
b.	0-35(3)	30	100		2	7	1	1.9
c.	0-35(4)	30	100		4	6		1.6
4.	20	40	300	1	6	3		1.2
5.	20	40	1000	1	8	1		1.0
6. a.	40-0	40	100		3	7		1.7
b.	40-0	40	100	1	4	5		1.4
c.	40-0	40	100	2	2	6		1.4
7.	30	40	1000	3	5	2		0.9
8. a.	40-0	40	300	1	7	2		1.1
b.	40-0	40	300	1	9			0.9
c.	40-0	40	300	1	9			0.9
9.	30	40	1000	1	7	2		1.1
10.	20	40	100		2	7	1	1.9
11.	40	40	100		2	7	1	1.9
12	20	40	1000	2	8			0.8
13.	30	40	300	1	8	1		1.0
14.	30	40	100		6	4		1.4
15. a.	0-35	30	300	1	7	2		1.1
b.	0-35	30	300	1	8	1		1.0
c.	0-35	30	300	1	8	1		1.0
16.	30	40	300	1	8	1		1.0
17. a.	0-35	30	1000	1	8	1		1.0
b.	0-35	30	1000	2	8			0.8
c.	0-35	30	1000	2	8			0.8
18.	20	40	100		2	8		1.8
19. a.	40-0	40	100		2	8		1.8
b.	40-0	40	100		3	7		1.7
c.	40-0	40	100		3	7		1.7

TABLE 16C. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Oily "O" Standard)

Run No.	Speed MPH	Load HP	Dilution Ratio (1)	"O" Standard Responses 0	1	2	3	Average
20. a.	40-0	40	100		4	6		1. 6
b.	40-0	40	100		5	5		1. 5
c.	40-0	40	100		5	5		1. 5
21.	30	40	1000	2	5	3		1. 1
22.	30	40	100	1	2	7		1. 6
23.a.	0-35	30	100		1	5	4	2. 3
b.	0-35	30	100		1	8	1	2. 0
c.	0-35	30	100		1	7	2	2. 1
24.	40	40	100	1	1	8		1. 7
25. a.	0-35	30	1000		5	5		1. 5
b.	0-35	30	1000	1	4	5		1. 4
c.	0-35	30	1000	2	7	1		0. 9

(1) - (9) See Table 16 for explanation.

TABLE 16D. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: November 23, 1966

Type Operation: Mixed Conditions

Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"A" Standard Responses 0	1	2	3	Ave.
1.	40	40	100	3	7			0.7
2. a.	40-0(6)	40(9)	1000	5	4	1		0.6
b.	40-0(7)	40	1000	6	3	1		0.5
c.	40-0(8)	40	1000	5	4	1		0.6
3. a.	0-35(2)	30(5)	100		7	3		1.3
b.	0-35(3)	30	100		6	4		1.4
c.	0-35(4)	30	100		6	4		1.4
4.	20	40	300	2	6	2		1.0
5.	20	40	1000	3	7			0.7
6. a.	40-0	40	100		5	5		1.5
b.	40-0	40	100		5	5		1.5
c.	40-0	40	100	1	5	4		1.3
7.	30	40	1000	3	7			0.7
8. a.	40-0	40	300	2	6	2		1.0
b.	40-0	40	300	4	5	1		0.7
c.	40-0	40	300	3	6	1		0.8
9.	30	40	1000	3	7			0.7
10.	20	40	100		7	3		1.3
11.	40	40	100		5	5		1.5
12.	20	40	1000	4	5	1		0.7
13.	30	40	300	3	7			0.7
14.	30	40	100	2	4	4		1.2
15. a.	0-35	30	300	3	6	1		0.8
b.	0-35	30	300	2	7	1		0.9
c.	0-35	30	300	1	8	1		1.0
16.	30	40	300	4	5	1		0.7
17. a.	0-35	30	1000	3	7			0.7
b.	0-35	30	1000	3	7			0.7
c.	0-35	30	1000	3	7			0.7
18.	20	40	100	1	5	4		1.3
19. a.	40-0	40	100	1	5	4		1.3
b.	40-0	40	100	1	5	4		1.3
c.	40-0	40	100	1	3	6		1.5

TABLE 16D. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Aromatic "A" Standard)

Run No.	Speed MPH	Load HP	Dilution Ratio(1)		"A" Standard Responses			
				0	1	2	3	Ave.
20. a.	40-0	40	100		8	2		1. 2
b.	40-0	40	100		7	3		1. 3
c.	40-0	40	100		8	2		1. 2
21.	30	40	1000	3	7			0. 7
22.	30	30	100	1	9			0. 9
23. a.	0-35	30	100		4	5	1	1. 7
b.	0-35	30	100	1	3	5	1	1. 6
c.	0-35	30	100		5	4	1	1. 6
24.	40	40	100	1	6	3		1. 2
25. a.	0-35	30	1000	3	7			0. 7
b.	0-35	30	1000	6	4			0. 4
c.	0-35	30	1000	6	4			0. 4

(1) - (9) See Table 16 for explanation.

TABLE 16E. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695 Type Operation: Mixed Conditions
Sample Method: Continuous
Date: November 23, 1966 Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio (1)	"P" Standard Responses			
				0	1	2	Average
1.	40	40	100	6	4		0.4
2. a.	40-0(6)	40(9)	1000	10			0
b.	40-0(7)	40	1000	9	1		0.1
c.	40-0(8)	40	1000	9	1		0.1
3. a.	0-35(2)	30(5)	100	2	8		0.8
b.	0-35(3)	30	100	2	8		0.8
c.	0-35(4)	30	100	3	7		0.7
4.	20	40	300	9	1		0.1
5.	20	40	1000	10			0.
6. a.	40-0	40	100	2	8		0.8
b.	40-0	40	100	3	7		0.7
c.	40-0	40	100	4	6		0.6
7.	30	40	1000	8	2		0.2
8. a.	40-0	40	300	10			0
b.	40-0	40	300	8	2		0.2
c.	40-0	40	300	7	3		0.3
9.	30	40	1000	7	3		0.3
10.	20	40	100	2	8		0.8
11.	40	40	100	1	9		0.9
12.	20	40	1000	7	3		0.3
13.	30	40	300	8	2		0.2
14.	30	40	100	5	5		0.5
15. a.	0-35	30	300	9	1		0.1
b.	0-35	30	300	8	2		0.2
c.	0-35	30	300	5	5		0.5
16.	30	40	300	8	2		0.2
17. a.	0-35	30	1000	9	1		0.1
b.	0-35	30	1000	9	1		0.2
c.	0-35	30	1000	9	1		0.1
18.	20	40	100	3	7		0.7
19. a.	40-0	40	100	4	6		0.6
b.	40-0	40	100	4	6		0.6
c.	40-0	40	100	1	8	1	1.0

TABLE 16E. SERIES 20 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Pungent "P" Standard)

Run No.	Speed MPH	Load HP	Dilution Ratio	"P" Standard Responses 0	1	2	Ave.
20. a.	40-0	40	100	4	6		0. 6
b.	40-0	40	100	4	6		0. 6
c.	40-0	40	100	4	6		0. 6
21.	30	40	1000	9	1		0. 1
22.	30	40	100	3	7		0. 7
23. a.	0-35	30	100		10		1. 0
b.	0-35	30	100		10		1. 0
c.	0-35	30	100		10		1. 0
24.	40	40	100	3	6	1	0. 8
25. a.	0-35	30	1000	6	4		0. 4
b.	0-35	30	1000	7	3		0. 3
c.	0-35	30	1000	8	2		0. 2

(1) - (9) See Table 16 for explanation.

Table 17. SERIES 20 REPRESENTATIVE OPERATING DATA

Vehicle: Bus 695
Sample Method: Continuous
Date: November 23, 1966

Type of Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	Temperatures, °F		Engine RPM
				Sample(9)	Stack(10)	
1.	40	40	100	385	590	1590
2. a	40-0(5)	40(8)	1000	148	550	1460
b	40-0(6)	40	1000	150	505	1000
c	40-0(7)	40	1000	154	450	660
3. a	0-35(1)	40(4)	100	202	270	1550
b	0-35(2)	40	100	236	345	1080
c	0-35(3)	40	100	280	435	1380
4.	20	40	300	202	375	780
5.	20	40	1000	144	375	780
6. a.	40-0	40	100	326	540	1460
b.	40-0	40	100	314	500	1000
c	40-0	40	100	284	430	660
7.	30	40	1000	126	450	1150
8. a	40-0	40	300	252	550	
b	40-0	40	300	240	508	
c	40-0	40	300	232	450	
9.	30	40	1000	150	450	1170
10.	20	40	100	280	400	780
11.	40	40	100	393	570	
12.	20	40	1000	154	390	800
13.	30	40	300	246	450	1190
14.	30	40	100	326	485	1190
15. a	0-35	40	300	170	270	1550
b	0-35	40	300	190	350	1100
c	0-35	40	300	216	450	1400
16.	30	40	300	232	485	1190
17. a	0-35	40	1000	130	260	1550
b	0-35	40	1000	140	340	1080
c	0-35	40	1000	146	450	1400

Table 17. SERIES 20 REPRESENTATIVE OPERATING DATA (Cont'd)

Run No.		Speed MPH	Load HP	Dilution Ratio	Temperatures, °F		Engine RPM
					Sample (9)	Stack (10)	
18.		20	40	100	280	400	800
19.	a	40-0	40	100	330	550	1460
	b	40-0	40	100	310	490	1000
	c	40-0	40	100	284	435	660
20.	a	40-0	40	100	324	535	1460
	b	40-0	40	100	312	485	1000
	c	40-0	40	100	290	420	660
21.		30	40	1000	160	455	1190
22.		30	40	100	306	450	1190
23.	a.	0-35	40	100	186	250	1550
	b	0-35	40	100	240	340	1100
	c	0-35	40	100	290	420	1400
24.		40	40	100	390	555	1590
25.	a	0-35	40	1000	140	270	1550
	b	0-35	40	1000	146	350	1100
	c	0-35	40	1000	154	490	1400

(1) "a" exposure is 3 seconds after start of open rack acceleration

(2) "b" exposure is 5 seconds after upshift

(3) "c" exposure is on reaching 35 mph

(4) Load is impressed at 30 mph and left in dynamometer throughout acceleration

(5) "a" exposure is 5 seconds after closed rack deceleration following one minute at high speed and load.

(6) "b" exposure is 25 seconds after closed rack deceleration following one minute at high speed and load.

(7) "c" exposure is on downshift (17 mph) after closed rack deceleration.

(8) Load at 40 mph for 1 minute, left in dynamometer during deceleration.

(9) Temperature at inlet to primary sample orifice, 8" from stack.

(10) Temperature in central exhaust stack at sample probe.

Table 18. SERIES 17 REPRESENTATIVE OPERATING DATA
(Constant Speed - Deceleration)

Vehicle: Bus 695
Sample Method: See Below
Date: November 17, 1966

Type Operation: Constant Speed - Deceleration
Vehicle Speed: 40-0 mph
Fuel: Reference No. 1

Vehicle Load: 40 hp at 40 mph for 1 minute, left in dynamometer during deceleration

Run No.		Sample Method	Dilution Ratio	Temperatures, °F Sample(4)	Temperatures, °F Stack(5)	Engine RPM
11.	a(1)	Proportional	330	246	525	1460
	b(2)		500	220	485	1000
	c(3)		850	196	425	660
12.	a	Constant	300	260	540	1460
	b		300	250	495	1000
	c		300	246	435	660
13.	a	Proportional	1050	160	525	1460
	b		1600	150	485	1000
	c		2650	136	425	660
14.	a	Constant	100	370	540	1460
	b		100	332	495	1000
	c		100	312	435	660
15.	a	Proportional	110	332	525	1460
	b		170	294	485	1000
	c		285	262	415	660
16.	a	Constant	1000	144	535	1460
	b		1000	150	494	1000
	c		1000	154	425	660
17.	a	Proportional	330	232	540	1460
	b		500	196	485	1000
	c		850	152	415	660
18.	a	Constant	300	250	525	1460
	b		300	242	475	1000
	c		300	240	415	660

(1) "a" exposure is 5 seconds after closed rack deceleration
(2) "b" exposure is 25 seconds after closed rack deceleration
(3) "c" exposure is on downshift (17 mph)
(4) Temperature at inlet to primary sample orifice, 8" from stack
(5) Temperature in central exhaust stack at sample probe

Table 19. CONSTANT SPEED SMOKE MEASUREMENT RESULTS
(Exploratory)

Vehicle: Bus 695
Inertia: Full Simulation

Fuel: Reference No. 1

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	Transmission Drive Range	PHS Smoke Reading %	Hartridge Smoke Units
1	10	850	0	Low	0.9	4.0
2	10	1000	12 max(1)	Low	1.0	4.5
3	15	1060	0	Low	0.9	4.5
4	15	1340	32 max	Low	1.0	5.0
5	20	1290	0	Low	0.9	4.0
6	20	1680	65 max	Low	1.0	10.0
7	23	1420	0	Low	1.0	4.0
8	23	1810	80 max	Low	2.0	26.0
9	20	890	0	Drive	1.0	5.0
10	20	900	45 max	Drive	10.0	56.0
11	25	1220	0	Drive	1.0	4.5
12	25	1220	65 max	Drive	9.5	52.0
13	30	1500	0	Drive	1.0	4.5
14	30	1360	65 max	Drive	10.0	55.0
15	35	1400	0	Drive	1.0	4.5
16	35	1380	65 max	Drive	6.0	36.0
17	40	1600	0	Drive	1.0	4.5
18	40	1580	60 max	Drive	3.5	26.0
19	45	1800	0	Drive	1.4	8.0
20	45	1790	40 max	Drive	3.4	22.0

(1) Open rack

Table 20. CONSTANT SPEED SMOKE MEASUREMENT RESULTS
(Transmission in Drive Range)

Vehicle: Bus 695
Inertia: Full Simulation

Fuel: Reference No. 1

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	PHS Smoke Reading %	Hartridge Smoke Units
1	20	890	0	1.0	6
2	20	890	20	1.2	9
3	20	890	30	1.3	10
4	20	890	40	2.0	17
5	20	890	45 max(1)	12	65
6	25	1000	0	0.8	4
7	25	1000	20	0.5	4
8	25	990	40	1.4	10
9	25	1000	50	3.5	20
10	25	1000	60	9.0	48
11	25	990	65 max	10	56
12	30	1210	0	1.0	6
13	30	1210	20	1.0	6
14	30	1210	40	1.5	11
15	30	1200	50	2.5	18
16	30	1210	60	6.0	32
17	30	1200	65	9.0	48
18	35	1420	0	0.7	4
19	35	1400	20	0.9	6
20	35	1420	40	1.1	8
21	35	1420	50	2.0	17
22	35	1400	60	4.8	29
23	35	1400	65	5.5	36
24	40	1590	0	1.5	7
25	40	1580	20	1.5	7
26	40	1590	40	2.1	10
27	40	1590	50	3.5	18
28	40	1580	55	3.6	19
29	40	1590	60	4.4	24
30	45	1800	0	1.0	7
31	45	1780	20	1.5	10
32	45	1800	30	1.4	8
33	45	1780	40	3.0	20

(1) Open rack operation

Table 21. IDLE-ACCELERATION-CONSTANT SPEED-DECELERATION SMOKE MEASUREMENT RESULTS

Vehicle: Bus 695
Inertia: Full Simulation **Fuel:** Reference No. 1

Run No.	Vehicle Load hp (1)	Maximum PHS Smoke Reading, %			
		Vehicle Speed mph	Engine Start (2)	Engine Acceleration (3)	Engine Upshift (4)
1	0	0-45-45-0	27.0	4.5	10
2	0	0-45-45-0	28.5	10.0	8
		Average	27.8	7.0	9
3	10	0-45-45-0	28.0	12.5	8.5
4	10	0-45-45-0	27.5	10.5	10.0
		Average	27.8	11.5	9.3
5	15	0-45-45-0	25.0	4.5	10.0
6	15	0-45-45-0	34.0	11.0	11.5
		Average	29.5	7.8	10.8
7	20	(5) 0-42-42-0	29.0	19.0	10.5
8	20	0-42-42-0	24.5	8.0	10.5
		Average	26.8	13.5	10.5
9	25	(5) 0-39-39-0	25.0	22.0	10.5
10	25	0-39-39-0	27.5	11.0	11.0
		Average	26.3	16.5	10.7
11	30	(5) 0-38-38-0	27.0	14.0	9.5
12	30	0-38-38-0	25.0	10.0	8.0
		Average	26.0	12.0	8.8

Table 21. (cont'd)

(1) Impressed at 30 mph and retained in dynamometer during acceleration and deceleration.

(2) One black puff on engine start.

(3) Open rack engine acceleration under full inertia simulation and load after 1 minute idle. Momentary black and blue puff.

(4) Engine upshift automatic at 24 mph. Smoke mostly black and reduces as engine speed and vehicle speed continue to increase.

(5) Maximum vehicle speed.

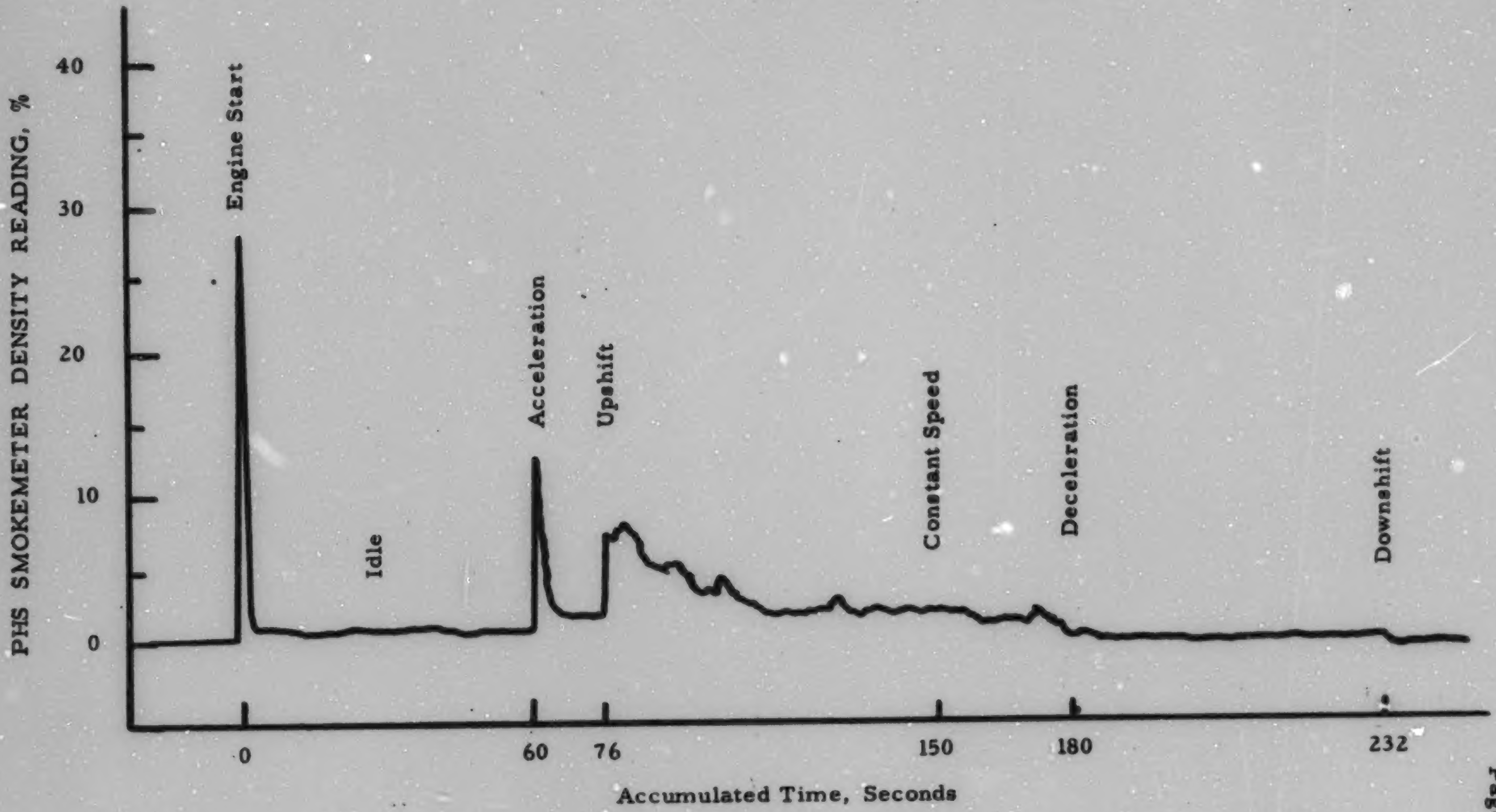
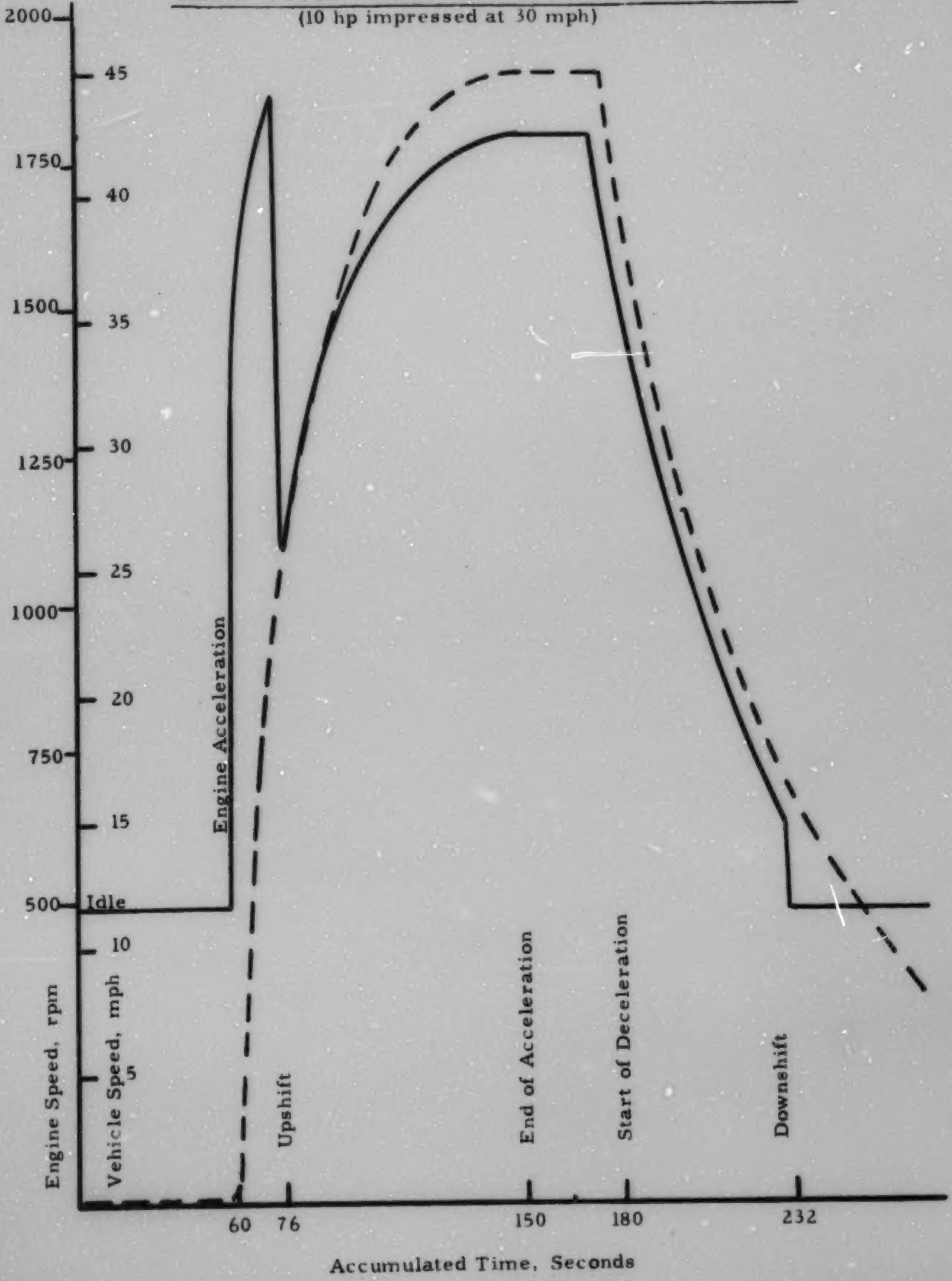


Figure 1. Run 23 IDLE-ACCELERATION-CONSTANT SPEED-DECELERATION BUS EXHAUST SMOKE
(10 hp Impressed in Dynamometer at 30 mph)

Figure 1A. Run 23 IDLE-ACCELERATION-CONSTANT SPEED-DECELERATION SMOKE CYCLE ENGINE & VEHICLE OPERATING DATA

(10 hp impressed at 30 mph)



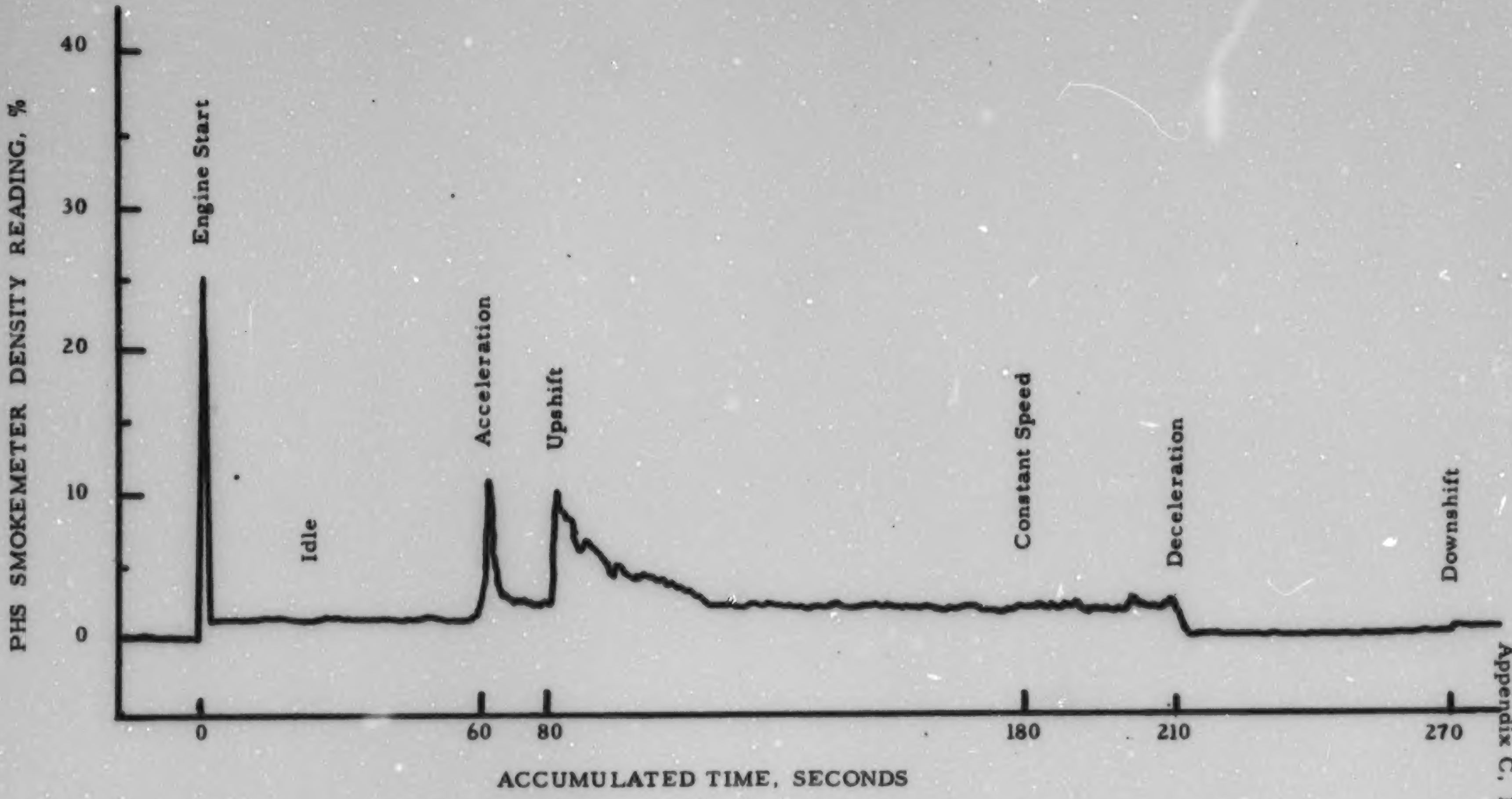


Figure 2. Run 26. IDLE-ACCELERATION-CONSTANT SPEED-DECELERATION BUS EXHAUST SMOKE
(15 hp impressed in Dynamometer at 30 mph)

Figure 2A. Run 26 IDLE-ACCELERATION-CONSTANT SPEED-DECELERATION SMOKE CYCLE ENGINE & VEHICLE OPERATING DATA
(15 hp impressed at 30 mph)

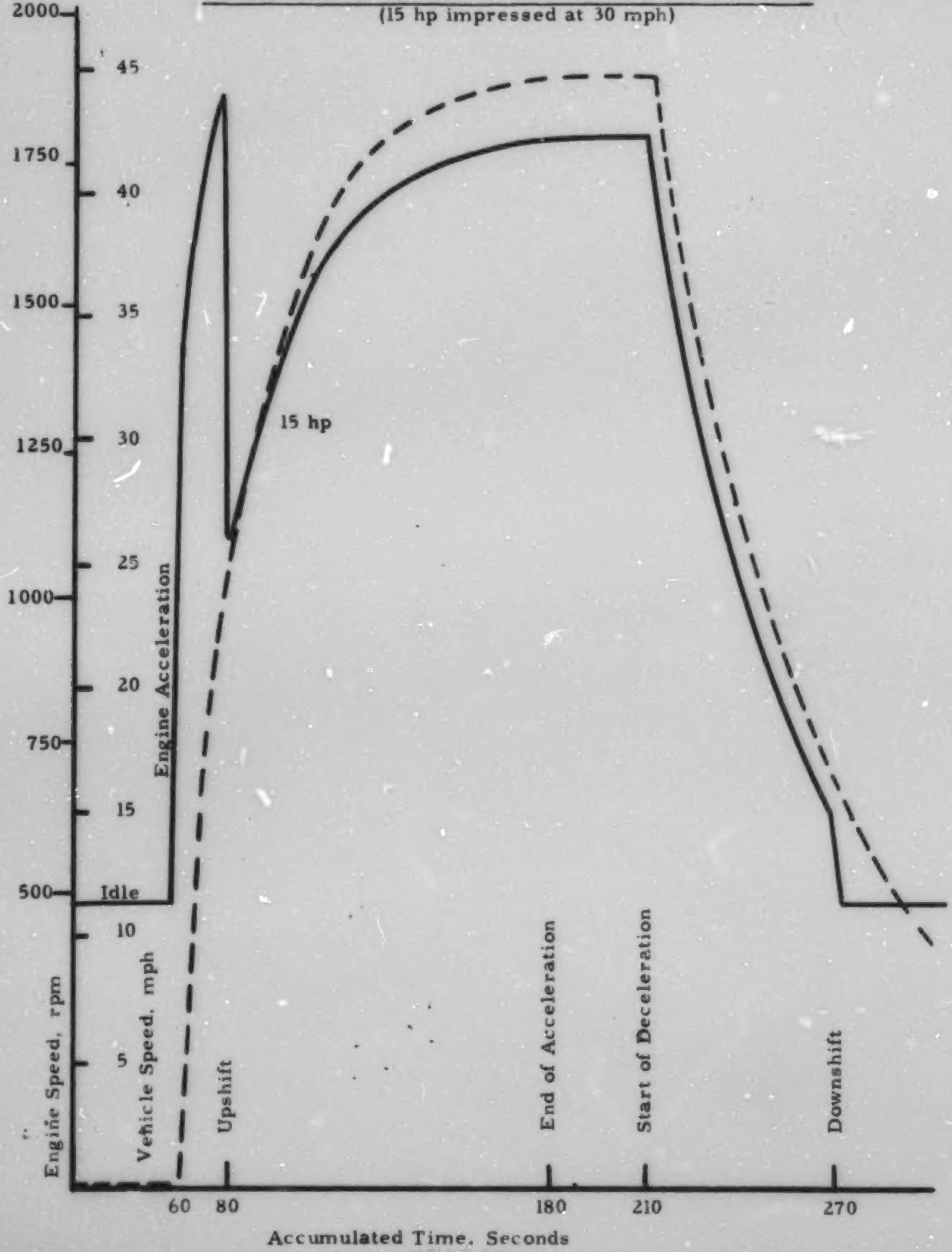


Table 22. ENGINE IDLE DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Tentative)

Applicability:	GM Truck and Coach Model 4519 City Bus powered by Detroit Diesel 6 V-71 engine
Sample Method:	Constant Sample flow using a separate orifice for 100:1, 300:1 and 1000:1 dilution levels.
Warm-up:	A minimum of three complete runs should be conducted prior to odor evaluation to assure the engine and system has reached operating temperature.
Vehicle Speed and Load:	Operate at 30 mph and 40 hp for one minute followed by closed rack deceleration to downshift (17 mph) and allow engine to idle. (air conditioning off and with inertia simulation)
Procedure:	(1) Operate at 30 mph and 40 hp, stable (2) Turn "on" panel warning light and maintain stable operation. (3) After one minute of stable sustained operation, closed rack deceleration to downshift and allow engine to idle. (4) Turn dilution system to "auto" 2 seconds after downshift. (5) Ring bell to begin panel exposure 15 seconds after downshift. (6) Panel turns "off" light when evaluation is complete. The evaluation requires 50-70 seconds to complete (note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with 2 to 3 exposures (sniffs) at will during the approximately 60 second period. (7) When light is "off", turn dilution system to "man" control and permit rear tires to rotate and cool. (8) Wait 5 minutes between runs for panel rest, tire cooling, and orifice change. (time starts when light goes "out".)
Run Time:	Approximately - 3 minutes with 5 minute rest - 8 minutes.

TABLE 23. SERIES 21. PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(BUS 695 - CONSTANT SPEED)

Run	Speed	Load	Dilution	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
No.	MPH	HP	Ratio	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
7.	0	0 (1)	100	8	7	7.4	3	2	2.4	3	1	2.1	3	1	2.0	2	0	1.3
13.	0	0	100	8	7	7.4	3	2	2.4	3	1	2.1	2	1	1.3	2	0	1.1
15.	0	0	100	8	7	7.7	3	2	2.6	3	1	2.5	2	1	1.7	2	0	1.3
19.	0	0	100	8	7	7.6	3	2	2.8	3	1	2.5	2	0	1.4	2	0	1.1
26.	0	0	100	8	6	7.3	3	2	2.5	3	1	2.3	2	0	1.4	2	0	1.3
						7.5			2.5			2.3			1.6			1.2
2.	0	40 (2)	100	7	6	6.8	3	2	2.4	3	1	2.2	2	0	1.1	2	0	1.1
6.	0	40	100	8	7	7.6	3	2	2.6	3	1	2.3	3	1	1.7	2	1	1.3
20.	0	40	100	8	7	7.6	3	1	2.7	3	1	2.5	2	1	1.2	2	0	1.2
22.	0	40	100	8	6	7.2	3	1	2.3	3	1	2.2	2	1	1.4	2	1	1.2
24.	0	40	100	8	7	7.4	3	1	2.5	3	1	2.2	2	1	1.6	2	1	1.2
27.	0	40	100	8	7	7.4	3	2	2.6	3	1	2.2	2	1	1.3	2	0	1.3
						7.3			2.5			2.3			1.4			1.2
3.	0	0	300	6	5	6.7	2	1	1.7	2	1	1.7	2	0	1.2	1	0	0.8
11.	0	0	300	7	6	6.4	3	1	1.4	3	1	1.4	2	1	1.1	2	0	1.1
17.	0	0	300	7	5	5.8	2	2	2.0	2	0	1.6	2	0	1.4	2	0	0.7
						6.3			1.7			2.7			1.2			0.9
4.	0	40	300	7	5	6.2	3	2	2.1	2	1	1.9	2	0	1.4	2	0	1.1
10.	0	40	300	6	5	5.2	2	1	1.5	2	1	1.5	2	1	1.2	2	0	0.6
16.	0	40	300	5	4	4.7	2	1	1.2	2	0	1.1	2	1	1.1	1	0	0.5
						5.4			1.6			1.5			1.2			0.7
1.	0	0	1000	6	4	5.3	2	1	1.8	2	1	1.6	1	1	1.0	1	0	0.7
5.	0	0	1000	6	4	5.2	2	1	1.5	2	0	1.3	2	1	1.3	2	0	0.4
9.	0	0	1000	6	4	4.8	2	1	1.3	2	0	1.0	2	1	1.1	1	0	0.7
21.	0	0	1000	5	4	4.4	2	1	1.2	2	0	1.1	1	1	1.0	2	0	0.6
23.	0	0	1000	5	4	4.6	2	1	1.4	2	0	1.0	2	0	1.0	1	0	0.7
28.	0	0	1000	5	4	4.8	2	1	1.2	2	0	1.1	1	0	0.8	1	0	0.6
						4.9			1.4			1.2			1.0			0.6

TABLE 23. SERIES 21. PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(BUS 695 - CONSTANT SPEED)

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
8.	0	40	1000	5	4	4.4	2	1	1.2	1	0	0.9	1	0	0.9	1	0	0.5
12.	0	40	1000	5	4	4.4	2	0	1.2	2	0	1.1	1	0	0.7	1	0	0.4
14.	0	40	1000	6	4	3.9	3	1	1.3	2	1	1.2	2	1	1.2	1	0	0.5
18.	0	40	1000	6	4	5.2	1	1	1.0	1	1	1.0	2	0	1.0	1	0	0.5
25.	0	40	1000	5	4	4.8	2	1	1.4	3	0	1.3	2	1	1.1	1	0	0.6
						4.5			1.2			1.1			1.0			0.5

(1) Operate at 30 mph and no load for one minute followed by closed rack to downshift and idle. Exposure 30 seconds after downshift.

(2) Same as (1) except operation at 30 mph and 40 hp for one minute . . .

Table 23A. SERIES 21 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 19, 1966

Type Operation: Constant
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite Responses 4	5	6	6.5	7	7.5	8	Average
1.	0	0(1)	1000	1	5	4					5.3
2.	0	40(2)	100			2		8			6.8
3.	0	0	300		3	7					6.7
4.	0	40	300		1	5	2	2			6.2
5.	0	0	1000	1	6	3					5.2
6.	0	40	100					4		6	7.6
7.	0	0	100					6	1	3	7.4
8.	0	40	1000	6	4						4.4
9.	0	0	1000	4	4	2					4.8
10.	0	40	300		8	2					5.2
11.	0	0	300			6		4			6.4
12.	0	40	1000	6	4						4.4
13.	0	0	100					6		4	7.4
14.	0	40	1000	4	3	3					3.9
15.	0	0	100					3		7	7.7
16.	0	40	300	3	7						4.7
17.	0	0	300		3	6		1			5.8
18.	0	40	1000	4		6					5.2
19.	0	0	100					4		6	7.6
20.	0	40	100					4		6	7.6
21.	0	0	1000	6	4						4.4
22.	0	40	100			3		2		5	7.2
23.	0	0	1000	4	6						4.6
24.	0	40	100					6	1	3	7.4
25.	0	40	1000	2	8						4.8
26.	0	0	100			2		3		5	7.3
27.	0	40	100					6		4	7.4
28.	0	0	1000	2	8						4.8

(1) - (2) See Table 23 for explanation.

TABLE 23B. SERIES 21 PROCEDURAL DEVELOPMENT RESULTS
(Burnt - Smoky "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 19, 1966

Type Operation: Constant
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"B" Burnt Responses 0	1	2	3	Average
1.	0	0(1)	1000		2	8		1.8
2.	0	40(2)	100			6	4	2.4
3.	0	0	300		3	7		1.7
4.	0	40	300			9	1	2.1
5.	0	0	1000		5	5		1.5
6.	0	40	100			4	6	2.6
7.	0	0	100			6	4	2.4
8.	0	40	1000		8	2		1.2
9.	0	0	1000		7	3		1.3
10.	0	40	300		5	5		1.5
11.	0	0	300		1	8	1	1.4
12.	0	40	1000	1	6	3		1.2
13.	0	0	100			6	4	2.4
14.	0	40	1000		8	1	1	1.3
15.	0	0	100			4	6	2.6
16.	0	40	300		8	2		1.2
17.	0	0	300			10		2.0
18.	0	40	1000		10			1.0
19.	0	0	100			2	8	2.8
20.	0	40	100		1	1	8	2.7
21.	0	0	1000		8	2		1.2
22.	0	40	100		1	5	4	2.3
23.	0	0	1000		6	4		1.4
24.	0	40	100		1	3	6	2.5
25.	0	40	1000		6	4		1.4
26.	0	0	100			5	5	2.5
27.	0	40	100			4	6	2.6
28.	0	0	1000		8	2		1.2

(1) - (2) See Table 23 for explanation.

TABLE 23C. SERIES 21 PROCEDURAL DEVELOPMENT RESULTS
(Oily "0" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 19, 1966

Type Operation: Constant
Vehicle Speed: See Below
Fuel: Reference No.: 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"O" Oily Responses 0	1	2	3	Average
1.	0	0(1)	1000		4	6		1.6
2.	0	40(2)	100		1	6	3	2.2
3.	0	0	300		3	7		1.7
4.		40	300		1	9		1.9
5.	0	0	1000	1	5	4		1.3
6.	0	40	100		2	3	5	2.3
7.	0	0	100		3	3	4	2.1
8.	0	40	1000	1	9			0.9
9.	0	0	1000	1	8	1		1.0
10.	0	40	300		5	5		1.5
11.	0	0	300		2	5	3	2.1
12.	0	40	1000	1	7	2		1.1
13.	0	0	100		2	5	3	2.1
14.	0	40	1000		8	2		1.2
15.	0	0	100		1	3	6	2.5
16.	0	40	300	1	7	2		1.1
17.	0	0	300	1	2	7		1.6
18.	0	40	1000		10			1.0
19.	0	0	100		1	3	6	2.5
20.	0	40	100		1	3	6	2.5
21.	0	0	1000	1	7	2		1.1
22.	0	40	100		3	2	5	2.2
23.	0	0	1000	1	8	1		1.0
24.	0	40	100		2	4	4	2.2
25.	0	40	1000	2	5	1	2	1.3
26.	0	0	100		1	5	4	2.3
27.	0	40	100		2	4	4	2.2
28.	0	0	1000	1	7	2		1.1

(1) - (2) See Table 23 for explanation.

TABLE 23D. SERIES 21 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 19, 1966

Type Operation: Constant
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"A" Aromatic Responses 0	1	2	3	Average
1.	0	0(1)	1000		10			1.0
2.	0	40(2)	100	1	7	2		1.1
3.	0	0	300	1	6	3		1.2
4.	0	40	300	1	4	5		1.4
5.	0	0	1000		7	3		1.3
6.	0	40	100		4	5	1	1.7
7.	0	0	100		1	8	1	2.0
8.	0	40	1000	1	9			0.9
9.	0	0	1000		9	1		1.1
10.	0	40	300		8	2		1.2
11.	0	0	300		9	1		1.1
12.	0	40	1000	3	7			0.7
13.	0	0	100		7	3		1.3
14.	0	40	1000		8	2		1.2
15.	0	0	100		3	7		1.7
16.	0	40	300		9	1		1.1
17.	0	0	300	1	4	5		1.4
18.	0	40	1000	1	8	1		1.0
19.	0	0	100	1	4	5		1.4
20.	0	40	100		8	2		1.2
21.	0	0	1000		10			1.0
22.	0	40	100		6	4		1.4
23.	0	0	1000	1	8	1		1.0
24.	0	40	100		4	6		1.6
25.	0	40	1000		9	1		1.1
26.	0	0	100	1	4	5		1.4
27.	0	40	100		7	3		1.3
28.	0	0	1000	2	8			0.8

(1) - (2) See Table 23 for explanation.

TABLE 23E. SERIES 21 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 19, 1966

Type Operation: Constant
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"P" Pungent Responses 0	1	2	Average
1.	0	0(1)	1000	3	7		0.7
2.	0	40(2)	100	1	7	2	1.1
3.	0	0	300	2	8		0.8
4.	0	40	300	1	7	2	1.1
5.	0	0	1000	7	2	1	0.4
6.	0	40	100		7	3	1.3
7.	0	0	100	1	5	4	1.3
8.	0	40	1000	5	5		0.5
9.	0	0	1000	3	7		0.7
10.	0	40	300	5	4	1	0.6
11.	0	0	300	1	7	2	1.1
12.	0	40	1000	6	4		0.4
13.	0	0	100	1	7	2	1.1
14.	0	40	1000	5	5		0.5
15.	0	0	100	2	3	5	1.3
16.	0	40	300	5	5		0.5
17.	0	0	300	4	5	1	0.7
18.	0	40	1000	5	5		0.5
19.	0	0	100	1	7	2	1.1
20.	0	40	100	1	6	3	1.2
21.	0	0	1000	5	4	1	0.6
22.	0	40	100		8	2	1.2
23.	0	0	1000	3	7		0.7
24.	0	40	100		8	2	1.2
25.	0	40	1000	4	6		0.6
26.	0	0	100	1	5	4	1.3
27.	0	40	100	1	5	4	1.3
28.	0	0	1000	4	6		0.6

(1) - (2) See Table 23 for explanation.

TABLE 24. SERIES 22 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Mixed Conditions)

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
13.	20(1)	40	100	9	8	8.7	3	2	2.7	4	2	3.1	3	1	2.3	2	1	1.7
17.	20	40	100	9	7	7.9	3	2	2.6	4	1	2.9	3	1	2.1	2	1	1.7
24.	20	40	100	9	8	8.6	3	2	2.5	4	2	3.1	4	2	2.5	3	1	1.6
						8.4			2.6			3.0			2.3			1.7
1.	20	40	1000	6	5	5.8	2	1	1.6	2	1	1.5	2	0	0.9	1	0	0.5
8.	20	40	1000	5	0	2.8	2	0	0.8	1	0	0.7	1	0	0.5	0	0	0
19.	20	40	1000	6	5	5.1	2	1	1.1	2	1	1.3	2	1	1.2	1	0	0.6
						4.6			1.2			1.2			0.9			0.4
3.	40(2)	40	100	9	8	8.2	3	2	2.9	3	1	2.3	2	1	1.5	2	1	1.8
6.	40	40	100	9	9	9.0	3	3	3.0	4	2	3.0	2	0	1.7	2	1	1.9
23.	40	40	100	10	10	10.0	3	2	2.9	4	2	3.3	3	1	2.4	3	1	2.2
						9.1			2.9			2.9			1.9			2.0
11.	40	40	1000	6	5	5.6	2	1	1.7	2	1	1.5	2	0	1.0	2	0	1.0
16.	40	40	1000	8	6	6.9	3	2	2.4	3	1	2.2	2	1	1.4	2	0	1.1
						6.3			2.1			1.9			1.2			1.1
9.	0(Idle)(3)	0	100	9	8	8.6	3	3	3.0	4	2	2.9	3	1	2.1	2	1	1.9
21.	0(Idle)	0	100	10	9	9.1	4	2	2.7	4	1	2.7	3	1	2.2	2	1	1.7
27.	0(Idle)	0	100	10	9	9.9	4	3	3.2	4	2	3.1	3	1	2.1	3	2	2.6
						9.3			3.0			2.9			2.1			2.0
5.	0(Idle)	0	1000	5	4	4.8	2	0	1.0	2	1	1.1	1	0	0.4	1	0	0.8
15.	0(Idle)	0	1000	7	5	6.2	3	1	1.9	2	0	1.3	2	0	1.5	2	0	1.0
						5.5			1.5			1.2			1.0			0.9
7.	0-20(4)	0	100	9	8	8.5	3	2	2.5	4	2	3.6	3	1	2.1	2	1	1.6
18.	0-20	0	100	10	9	9.6	4	4	4.0.	4	2	3.5	3	2	2.5	3	1	2.0
26.	0-20	0	100	10	8	9.1	3	2	2.8	4	2	3.2	3	1	2.0	2	2	2.0
						9.1			3.1			3.4			2.2			2.8

TABLE 24. SERIES 22 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Mixed Conditions)

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"[illegible]" Oily Max.	"[illegible]" Oily Min.	"[illegible]" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
2.	0-20	0	1000	7	5	6.2	3	1	2.2	2	1	1.7	2	0	1.1	2	0	1.2
12.	0-20	0	1000	6	4	5.3	2	1	1.5	2	0	1.3	2	0	0.9	1	0	0.6
22.	0-20	0	1000	9	6	8.1	3	2	2.6	3	1	2.3	3	1	1.8	2	0	1.1
						6.5			2.1			1.8			1.3			1.0
10.	40-0(5)	40	100	9	7	8.3	3	2	2.1	4	1	2.5	3	2	2.5	1	0	0.3
20.	40-0	40	100	10	8	9.0	3	2	2.8	3	2	2.6	3	2	2.3	2	1	1.9
						8.7			2.5			2.6			2.4			1.0
4.	40-0	40	1000	6	3	4.2	2	1	1.1	2	0	0.9	1	0	0.4	1	0	0.3
14.	40-0	40	1000	6	3	4.9	2	1	1.3	2	0	1.4	2	0	1.0	2	0	0.6
25.	40-0	40	1000	7	5	5.6	2	1	1.7	3	1	1.6	3	1	1.4	2	0	1.0
						4.9			1.4			1.3			0.9			0.6

(1) Constant Speed Condition
(2) Constant Speed Condition
(3) Constant Speed followed by idle Condition
(4) Idle-acceleration, exposure 3 seconds after acceleration
(5) Constant Speed - deceleration, exposure at 23 mph

TABLE 24A. SERIES 22 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 20, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run	Speed	Load	Dilution	"D" Composite Responses										
No.	MPH	HP	Ratio	0	2	3	4	5	6	7	8	9	10	Average
1.	20(1)	40	1000					2	8					5.8
2.	0-20(4)	0	1000					1	3	6				6.2
3.	40(2)	40	100								8	2		8.2
4.	40-0(5)	40	1000			3	3	3	1					4.2
5.	0(3)	0	1000				2	8						4.8
6.	40	40	100									10		9.0
7.	0-20	0	100								5	5		8.5
8.	20	40	1000	2	2	1	4		1					2.8
9.	0	0	100								4	6		8.6
10.	40-0	40	100							2	3	5		8.3
11.	40	40	1000					4	6					5.6
12.	0-20	0	1000				3	1	6					5.3
13.	20	40	100								3	7		8.7
14.	40-0	40	1000			1	2	4	3					4.9
15.	0	0	1000					1	6	3				6.2
16.	40	40	1000						3	5	2			6.9
17.	20	40	100							2	7	1		7.9
18.	0-20	0	100									4	6	9.6
19.	20	40	1000					9	1					5.1
20.	40-0	40	100								1	8	1	9.0
21.	0	0	100									9	1	9.1
22.	0-20	0	1000						2	1	1	6		8.1
23.	40	40	100										10	10.0
24.	20	40	100								4	6		8.6
25.	40-0	40	1000					5	4	1				5.6
26.	0-20	0	100								1	7	2	9.1
27.	0	0	100									1	9	9.9

(1) - (5) See Table 24 for explanation.

TABLE 24B. SERIES 22 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky-"B" Standard)

Vehicle: Bus 695	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See below
Date: December 20, 1966	Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"B" Burnt - Responses					
				0	1	2	3	4	Average
1.	20(1)	40	1000		4	6			1.6
2.	0-20(4)	0	1000		2	4	4		2.2
3.	40(2)	40	100			1	9		2.9
4.	40-0(5)	40	1000		9	1			1.1
5.	0(3)	0	1000	1	8	1			1.0
6.	40	40	100				10		3.0
7.	0-20	0	100			5	5		2.5
8.	20	40	1000	3	6	1			0.8
9.	0	0	100				10		3.0
10.	40-0	40	100			9	1		2.1
11.	40	40	1000		3	7			1.7
12.	0-20	0	1000		5	5			1.5
13.	20	40	100			3	7		2.7
14.	40-0	40	1000		7	3			1.3
15.	0	0	1000		2	7	1		1.9
16.	40	40	1000			6	4		2.4
17.	20	40	100			4	6		2.6
18.	0-20	0	100					10	4.0
19.	20	40	1000		9	1			1.1
20.	40-0	40	100			2	8		2.8
21.	0	0	100			4	5	1	2.7
22.	0-20	0	1000			4	6		2.6
23.	40	40	100			1	9		2.9
24.	20	40	100			5	5		2.5
25.	40-0	40	1000		3	7			1.7
26.	0-20	0	100			2	8		2.8
27.	0	0	100				8	2	3.2

(1) - (5) See Table 24 for explanation.

TABLE 24C. SERIES 22 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 20, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"O" Oily Responses 0	1	2	3	4	Average
1.	20(1)	40	1000		5	5			1.5
2.	0-20(4)	0	1000		4	5	1		1.7
3.	40(2)	40	100		1	5	4		2.3
4.	40-0(5)	40	1000	2	7	1			0.9
5.	0(3)	0	1000		9	1			1.1
6.	40	40	100			2	6	2	3.0
7.	0-20	0	100			1	2	7	3.6
8.	20	40	1000	3	7				0.7
9.	0	0	100			2	7	1	2.9
10.	40-0	40	100		2	4	1	3	2.5
11.	40	40	1000		5	5			1.5
12.	0-20	0	1000	1	5	4			1.3
13.	20	40	100			2	5	3	3.1
14.	40-0	40	1000	1	4	5			1.4
15.	0	0	1000	2	3	5			1.3
16.	40	40	1000		1	6	3		2.2
17.	20	40	100		1		8	1	2.9
18.	0-20	0	100			1	3	6	3.5
19.	20	40	1000		7	3			1.3
20.	40-0	40	100			4	6		2.6
21.	0	0	100		1	3	4	2	2.7
22.	0-20	0	1000		1	5	4		2.3
23.	40	40	100			1	5	4	3.3
24.	20	40	100			3	3	4	3.1
25.	40-0	40	1000		6	2	2		1.6
26.	0-20	0	100			1	6	3	3.2
27.	0	0	100			2	5	3	3.1

(1) - (5) See Table 24 for explanation.

TABLE 24D. SERIES 22 PROCEDURAL DEVELOPMENT RESULTS

(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: 12-20-66

Type Operation: Mixed Conditions
Vehicle Speed: See below
Fuel: Reference No. 1

Run	Speed	Load	Dilution	"A" Aromatic Responses					
No.	MPH	HP	Ratio	0	1	2	3	4	Average
1.	20(1)	40	1000	2	7	1			0.9
2.	0-20(4)	0	1000	1	7	2			1.1
3.	40(2)	40	100		5	5			1.5
4.	40-0(5)	40	1000	6	4				0.4
5.	0(3)	0	1000	6	4				0.4
6.	40	40	100	1	1	8			1.7
7.	0-20	0	100		1	7	2		2.1
8.	20	40	1000	5	5				0.5
9.	0	0	100		2	5	3		2.1
10.	40-0	40	100			5	5		2.5
11.	40	40	1000	1	8	1			1.0
12.	0-20	0	1000	2	7	1			0.9
13.	20	40	100		1	5	4		2.3
14.	40-0	40	1000	3	4	3			1.0
15.	0	0	1000	1	3	6			1.5
16.	40	40	1000		6	4			1.4
17.	20	40	100		1	7	2		2.1
18.	0-20	0	100			5	5		2.5
19.	20	40	1000		8	2			1.2
20.	40-0	40	100			7	3		2.3
21.	0	0	100		2	4	4		2.2
22.	0-20	0	1000		3	6	1		1.8
23.	40	40	100		1	4	5		2.4
24.	20	40	100			6	3	1	2.5
25.	40-0	40	1000		8		2		1.4
26.	0-20	0	100		1	8	1		2.0
27.	0	0	100		2	5	3		2.1

(1) - (5) See Table 24 for explanation.

TABLE 24E. SERIES 22 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 20, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"P" Pungent Responses 0	1	2	3	Average
1.	20(1)	40	1000	5	5			0.5
2.	0-20(4)	0	1000	2	4	4		1.2
3.	40(2)	40	100		2	8		1.8
4.	40-0(5)	40	1000	7	3			0.3
5.	0(3)	0	1000	2	8			0.8
6.	40	40	100		1	9		1.9
7.	0-20	0	100		4	6		1.6
8.	20	40	1000	10				0
9.	0	0	100		1	9		1.9
10.	40-0	40	100	7	3			0.3
11.	40	40	1000	1	8	1		1.0
12.	0-20	0	1000	4	6			0.6
13.	20	40	100		3	7		1.7
14.	40-0	40	1000	5	4	1		0.6
15.	0	0	1000	2	6	2		1.0
16.	40	40	1000	2	5	3		1.1
17.	20	40	100		3	7		1.7
18.	0-20	0	100		1	8	1	2.0
19.	20	40	1000	4	6			0.6
20.	40-0	40	100		1	9		1.9
21.	0	0	100		3	7		1.7
22.	0-20	0	1000	2	5	3		1.1
23.	40	40	100		1	6	3	2.2
24.	20	40	100		6	2	2	1.6
25.	40-0	40	1000	2	6	2		1.0
26.	0-20	0	100			10		2.0
27.	0	0	100			4	6	2.6

(1) - (5) See Table 24 for explanation.

TABLE 25. SERIES 23 PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(Bus 695 - Mixed Conditions)

Run	Speed	Load	Dilution	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
No.	MPH	HP	Ratio	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
3.	20(1)	40	100	9	8	8.3	3	2	2.7	3	2	2.6	2	1	1.8	2	1	1.3
14.	20	40	100	8	7	7.7	3	2	2.5	3	1	2.4	2	0	1.6	2	0	1.2
22.	20	40	100	9	7	7.9	4	2	2.8	3	1	2.4	2	1	1.6	2	0	0.9
27.	20	40	100	10	7	8.0	3	2	2.6	3	1	2.3	3	1	1.6	2	1	1.3
						8.0			2.7			2.4			1.7			1.2
4.	20	40	1000	5	4	4.2	2	1	1.1	2	1	1.2	1	0	0.5	1	0	0.2
11.	20	40	1000	4	3	3.7	2	0	0.9	2	0	0.9	1	0	0.5	1	0	0.2
						4.0			1.0			1.1			0.5			0.2
8.	40(2)	40	100	9	8	8.3	3	2	2.8	3	2	2.6	3	1	2.1	2	1	1.5
15.	40	40	100	9	7	8.4	3	2	2.9	3	2	2.6	3	1	1.8	2	1	1.4
25.	40	40	100	9	7	9.1	3	2	2.9	4	2	2.9	3	1	2.0	2	1	1.8
						8.6			2.9			2.7			2.0			1.6
9.	40	40	1000	5	4	4.5	2	0	0.9	2	1	1.1	2	0	1.0	2	0	0.4
18.	40	40	1000	5	3	4.1	2	0	1.0	2	1	1.1	2	0	1.0	1	0	0.4
30.	40	40	1000	5	4	4.4	2	1	1.3	2	1	1.2	2	0	1.0	1	0	0.2
						4.3			1.1			1.1			1.0			0.3
2.	0(Idle)(3)	0	100	8	7	7.9	3	2	2.7	3	2	2.3	3	1	1.7	2	1	1.1
10.	0(Idle)	0	100	7	5	6.2	2	0	1.7	2	1	1.5	2	0	1.3	2	0	0.7
23.	0(Idle)	0	100	10	8	9.5	4	2	3.1	4	2	3.2	3	1	1.9	2	1	1.7
26.	0(Idle)	0	100	9	6	7.8	3	2	2.6	3	1	2.1	3	1	1.6	2	1	1.6
28.	0(Idle)	0	100	9	7	7.4	3	2	2.4	3	1	1.9	3	1	1.6	2	0	1.4
						7.8			2.5			2.2			1.6			1.3
16.	0(Idle)	0	1000	5	1	4.1	2	0	0.9	2	0	1.1	1	1	1.0	1	0	0.5
20.	0(Idle)	0	1000	5	3	4.3	2	1	1.1	1	1	1.0	2	0	0.7	1	0	0.5
						4.2			1.0			1.1			0.9			0.5

TABLE 25. SERIES 23 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695- Mixed Conditions)

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
12.	0-20(4)	0	100	10	8	8.9	2	1	1.9	4	2	3.0	3	1	2.0	2	0	1.4
17.	0-20	0	100	9	7	7.8	3	2	2.5	3	2	2.7	2	1	1.6	2	0	1.4
29.	0-20	0	100	10	9	9.7	4	2	3.1	4	2	2.6	3	1	2.1	3	1	2.0
						8.8			2.5			2.8			1.9			1.6
6.	0-20	0	1000	7	5	5.8	3	1	2.0	3	1	1.6	2	1	1.1	1	0	0.9
21.	0-20	0	1000	7	4	5.5	2	1	1.7	3	1	1.6	2	1	1.2	1	0	0.6
24.	0-20	0	1000	8	5	7.2	3	2	2.3	3	1	2.0	3	1	1.5	2	0	1.0
						6.2			2.0			1.7			1.3			0.8
5.	40-0(5)	40	100	9	7	8.1	3	2	2.7	3	2	2.3	2	1	1.6	2	1	1.5
7.	40-0	40	100	8	7	7.3	3	2	2.4	3	1	2.0	2	1	1.4	1	0	0.9
19.	40-0	40	100	9	7	7.8	3	2	2.7	3	2	2.6	2	1	1.8	2	1	1.3
						7.7			2.6			2.3			1.6			1.2
1.	40-0	40	1000	5	4	4.6	2	1	1.4	2	1	1.2	2	0	0.8	1	0	0.2
13.	40-0	40	1000	4	3	3.4	1	1	1.0	2	1	1.1	2	0	0.6	1	0	0.2
						4.0			1.2			1.2			0.7			0.2

(1) Constant Speed Condition
(2) Constant Speed Condition
(3) Constant Speed followed by idle Condition
(4) Idle-acceleration, exposure 3 seconds after acceleration
(5) Constant Speed - deceleration, exposure at 23 mph

TABLE 25A. SERIES 23 PROCEDURAL DEVELOPMENT RESULTS
(Diesel Composite "D" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 21, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run	Speed	Load	Dilution	"D" Diesel Composite Responses										
No.	MPH	HP	Ratio	1	2	3	4	5	6	7	8	9	10	Average
1.	40-0(5)	40	1000				4	6						4.6
2.	0(3)	0	100							1	9			7.9
3.	20(1)	40	100								7	3		8.3
4.	20	40	1000				8	2						4.2
5.	40-0	40	100							4	1	5		8.1
6.	0-20(4)	0	1000					4	4	2				5.8
7.	40-0	40	100							7	3			7.3
8.	40(2)	40	100								7	3		8.3
9.	40	40	1000				5	5						4.5
10.	0	0	100					1	6	3				6.2
11.	20	40	1000			3	7							3.7
12.	0-20	0	100								3	5	2	8.9
13.	40-0	40	1000			6	4							3.4
14.	20	40	100							3	7			7.7
15.	40	40	100							1	4	5		8.4
16.	0	0	1000	1	1		2	6						4.1
17.	0-20	0	100							3	6	1		7.8
18.	40	40	1000			1	7	2						4.1
19.	40-0	40	100							3	6	1		7.8
20.	0	0	1000			1	5	4						4.3
21.	0-20	0	1000				1	4	4	1				5.5
22.	20	40	100							3	5	2		7.9
23.	0	0	100								1	3	6	9.5
24.	0-20	0	1000					3	2		5			7.2
25.	40	40	100								1	7	2	9.1
26.	0	0	100						1	2	5	2		7.8
27.	20	40	100							3	5	1	1	8.0
28.	0	0	100							7	2	1		7.4
29.	0	0	100									3	7	9.7
30.	40	40	1000				6	4						4.4

(1) - (5) See Table 25 for explanation.

TABLE 25B. SERIES 23 PROCEDURAL DEVELOPMENT RESULTS
(Burnt "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 21, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"B" Burnt Responses 0	1	2	3	4	Average
1.	40-0(5)	40	1000		6	4			1.4
2.	0(3)	0	100			3	7		2.7
3.	20(1)	40	100			3	7		2.7
4.	20	40	1000		9	1			1.1
5.	40-0	40	100			3	7		2.7
6.	0-20(4)	0	1000		1	8	1		2.0
7.	40-0	40	100			6	4		2.4
8.	40(2)	40	100			2	8		2.8
9.	40	40	1000	3	5	2			0.9
10.	0	0	100	1	1	8			1.7
11.	20	40	1000	2	7	1			0.9
12.	0-20	0	100		1	9			1.9
13.	40-0	40	1000		10				1.0
14.	20	40	100			5	5		2.5
15.	40	40	100			1	9		2.9
16.	0	0	1000	3	5	2			0.9
17.	0-20	0	100			5	5		2.5
18.	40	40	1000	1	8	1			1.0
19.	40-0	40	100			3	7		2.7
20.	0	0	1000		9	1			1.1
21.	0-20	0	1000		3	7			1.7
22.	20	40	100			3	6	1	2.8
23.	0	0	100			1	7	2	3.1
24.	0-20	0	1000			7	3		2.3
25.	40	40	100			1	9		2.9
26.	0	0	100			4	6		2.6
27.	20	40	100			4	6		2.6
28.	0	0	100			6	4		2.4
29.	0-20	0	100			1	7	2	3.1
30.	40	40	1000		7	3			1.3

(1) - (5) See Table 25 for explanation.

TABLE 25C. SERIES 23 PROCEDURAL DEVELOPMENT RESULTS
(Oily "0" Standard)

Vehicle: Bus 695	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 21, 1966	Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"O" Oily Responses 0	1	2	3	4	Average
1.	40-0(5)	40	1000		8	2			1.2
2.	0(3)	0	100			7	3		2.3
3.	20(1)	40	100			4	6		2.6
4.	20	40	1000		8	2			1.2
5.	40-0	40	100			7	3		2.3
6.	0-20(4)	0	1000		5	4	1		1.6
7.	40-0	40	100		2	6	2		2.0
8.	40(2)	40	100			4	6		2.6
9.	40	40	1000		9	1			1.1
10.	0	0	100		5	5			1.5
11.	20	40	1000	2	7	1			0.9
12.	0-20	0	100			1	8	1	3.0
13.	40-0	40	1000		9	1			1.1
14.	20	40	100		1	4	5		2.4
15.	40	40	100			4	6		2.6
16.	0	0	1000	1	7	2			1.1
17.	0-20	0	100			3	7		2.7
18.	40	40	1000		9	1			1.1
19.	40-0	40	100			4	6		2.6
20.	0	0	1000		10				1.0
21.	0-20	0	1000		5	4	1		1.6
22.	20	40	100		1	4	5		2.4
23.	0	0	100			2	4	4	3.2
24.	0-20	0	1000		3	4	3		2.0
25.	40	40	100			3	5	2	2.9
26.	0	0	100		1	7	2		2.1
27.	20	40	100		1	5	4		2.3
28.	0	0	100		2	7	1		1.9
29.	0-20	0	100			5	4	1	2.6
30.	40	40	1000		8	2			1.2

(1) - (5) See Table 25 for explanation.

TABLE 25D. SERIES 23 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 21, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"A" Aromatic Responses 0	1	2	3	Average
1.	40-0(5)	40	1000	3	6	1		0.8
2.	0(3)	0	100		4	5	1	1.7
3.	20(1)	40	100		2	8		1.8
4.	20	40	1000	5	5			0.5
5.	40-0	40	100		5	4	1	1.6
6.	0-20(4)	0	1000		9	1		1.1
7.	40-0	40	100		6	4		1.4
8.	40(2)	40	100		1	7	2	2.1
9.	40	40	1000	3	4	3		1.0
10.	0	0	100	1	5	4		1.3
11.	20	40	1000	5	5			0.5
12.	0-20	0	100		1	8	1	2.0
13.	40-0	40	1000	5	4	1		0.6
14.	20	40	100	1	2	7		1.6
15.	40	40	100		4	4	2	1.8
16.	0	0	1000		10			1.0
17.	0-20	0	100		4	6		1.6
18.	40	40	1000	2	6	2		1.0
19.	40-0	40	100		3	6	1	1.8
20.	0	0	1000	5	3	2		0.7
21.	0-20	0	1000		8	2		1.2
22.	20	40	100		4	6		1.6
23.	0	0	100		2	7	1	1.9
24.	0-20	0	1000		6	3	1	1.5
25.	40	40	100		1	8	1	2.0
26.	0	0	100		5	4	1	1.6
27.	20	40	100		5	4	1	1.6
28.	0	0	100		5	4	1	1.6
29.	0-20	0	100		1	7	2	2.1
30.	40	40	1000	1	8	1		1.0

(1) - (5) See Table 25 for explanation.

TABLE 25E. SERIES 23 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 21, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"P" Pungent Responses				
				0	1	2	3	Average
1.	40-0(5)	40	1000	8	2			0.2
2.	0(3)	0	100		9	1		1.1
3.	20(1)	40	100		7	3		1.3
4.	20	40	1000	8	2			0.2
5.	40-0	40	100		5	5		1.5
6.	0-20(4)	0	1000	2	7	1		0.9
7.	40-0	40	100	1	9			0.9
8.	40(2)	40	100		5	5		1.5
9.	40	40	1000	8	2	1		0.4
10.	0	0	100	4	5	1		0.7
11.	20	40	1000	8	2			0.2
12.	0-20	0	100	1	4	5		1.4
13.	40-0	40	1000	8	2			0.2
14.	20	40	100	1	6	3		1.2
15.	40	40	100		6	4		1.4
16.	0	0	1000	5	5			0.5
17.	0-20	0	100	1	4	5		1.4
18.	40	40	1000	6	4			0.4
19.	40-0	40	100		7	3		1.3
20.	0	0	1000	5	5			0.5
21.	0-20	0	1000	4	6			0.6
22.	20	40	100	3	5	2		0.9
23.	0	0	100		3	7		1.7
24.	0-20	0	1000	2	6	2		1.0
25.	40	40	100		2	8		1.8
26.	0	0	100		4	6		1.6
27.	20	40	100		7	3		1.3
28.	0	0	100	1	4	5		1.4
29.	0-20	0	100		3	4	3	2.0
30.	40	40	1000	8	2			0.2

(1) - (5) See Table 25 for explanation.

TABLE 26. SERIES 24 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695-Mixed Conditions)

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
2.	20(1)	40	100	7	7	7.0	3	2	2.3	3	2	2.1	2	1	1.3	2	1	1.2
9.	20	40	100	7	4	5.9	2	1	1.6	2	1	1.7	2	1	1.2	1	0	0.6
12.	20	40	100	8	5	6.3	3	0	1.7	3	1	1.4	2	0	1.2	2	0	0.9
15.	20	40	100	7	4	6.1	3	1	1.9	3	0	1.7	2	1	1.3	2	0	0.9
						6.3			1.9			1.7			1.3			0.9
7.	40(2)	40	100	8	7	7.2	3	2	2.4	3	1	2.3	2	1	1.3	2	1	1.5
13.	40	40	100	9	5	7.6	3	1	2.3	3	1	2.4	3	1	1.8	3	0	1.6
19.	40	40	100	8	6	7.2	3	1	2.5	3	1	2.1	3	1	1.7	2	0	1.3
22.	40	40	100	9	7	7.8	3	2	2.6	3	1	2.5	3	0	1.6	2	1	1.4
						7.5			2.5			2.3			1.6			1.5
3.	0(Idle)(3)	0	100	8	6	7.0	3	2	2.5	3	1	2.1	2	0	1.2	2	1	1.2
16.	0(Idle)	0	100	9	5	7.2	3	1	2.3	3	1	2.2	3	1	1.9	2	0	1.3
						7.1			2.4			2.2			1.6			1.3
5.	0-20(4)	0	100	8	7	7.8	3	2	2.6	3	1	2.3	2	1	1.5	3	1	1.5
18.	0-20	0	100	8	6	5.9	3	0	2.2	3	0	1.9	2	0	1.3	2	0	1.1
20.	0-20	0	100	8	7	7.5	3	1	2.5	3	1	2.3	3	1	1.7	2	0	1.3
						7.1			2.4			2.3			1.5			1.3
1.	40-0(5)	40	100	7	6	6.2	3	2	2.1	2	1	1.7	2	1	1.3	2	1	1.2
6.	40-0	40	100	8	6	6.9	3	1	2.3	3	1	2.3	2	1	1.2	2	0	1.3
10.	40-0	40	100	7	5	6.2	2	1	1.7	2	1	1.5	2	1	1.4	2	0	1.3
						6.4			2.1			1.8			1.3			1.3

TABLE 26. SERIES 24 PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(Bus 695-Mixed Conditions)

Run	Speed	Load	Dilution	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
No.	MPH	HP	Ratio	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
4. (6)	0	0	-	3	0	1.6	1	0	0.6	1	0	0.5	1	0	0.6	1	0	0.5
8.	0	0	-	3	0	1.1	1	0	0.5	2	0	0.5	2	0	0.3	1	0	0.1
11.	0	0	-	4	0	1.8	1	0	0.5	1	0	0.3	1	0	0.6	1	0	0.1
14.	0	0	-	3	0	1.6	1	0	0.7	1	0	0.2	0	0	0	0	0	0
17.	0	0	-	2	0	1.1	1	0	0.6	1	0	0.3	1	0	0.1	1	0	0.3
21.	0	0	-	4	0	2.0	1	0	0.5	1	0	0.4	2	0	0.3	1	0	0.2
						1.5			0.6			0.4			0.3			0.2

(1) Constant Speed Condition
(2) Constant Speed Condition
(3) Constant Speed followed by idle Condition
(4) Idle-acceleration, exposure 3 seconds after acceleration
(5) Constant Speed - deceleration, exposure at 23 mph
(6) Runs 4, 8, 11, 14, 17 and 21 were blank runs, no exhaust sample obtained

TABLE 26A. SERIES 24 PROCEDURAL DEVELOPMENT RESULTS
(Diesel "D" Composite Standard)

Vehicle: Bus 695	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 22, 1966	Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Diesel Composite Responses										
				0	1	2	3	4	5	6	7	8	9	Average
1.	40-0(5)	40	100							8	2			6.2
2.	20(1)	40	100								10			7.0
3.	0(Idle)(3)	0	100							3	4	3		7.0
4.	BLANK		(6)	2	1	6	1							1.6
5.	0-20(4)	0	100								2	8		7.8
6.	40-0	40	100							3	5	2		6.9
7.	40(2)	40	100								8	2		7.2
8.	BLANK			4	2	3	1							1.1
9.	20	40	100					1	1	6	2			5.9
10.	40-0	40	100						2	4	4			6.2
11.	BLANK			1	5		3	1						1.8
12.	20	40	100						4	2	1	3		6.3
13.	40	40	100						2			6	2	7.6
14.	BLANK			2	1	6	1							1.6
15.	20	40	100						1	4	4			6.1
16.	0(Idle)	0	100						2	1	2	3	2	7.2
17.	BLANK				7	2								1.1
18.	0-20	0	100	1	1					1	4	3		5.9
19.	40	40	100							2	4	4		7.2
20.	0-20	0	100								5	5		7.5
21.	BLANK			3	1	2	1	3						2.0
22.	0	40	100								3	6	1	7.8

Runs 4, 8, 11, 14, 17, 21 were blank, no exhaust sample obtained.

(1) - (6) See Table 26 for explanation.

TABLE 26B. SERIES 24 PROCEDURAL DEVELOPMENT RESULTS

(Burnt "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 22, 1966

Type Operation: Mixed Condition
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"B" Burnt Responses				
				0	1	2	3	Average
1.	40-0(5)	40	100			9	1	2.1
2.	20(1)	40	100			7	3	2.3
3.	0-(Idle)(3)	0	100			5	5	2.5
4.	BLANK		(6)	4	6			0.6
5.	0-20(4)	0	100			4	6	2.6
6.	40-0	40	100		1	4	5	2.3
7.	40(2)	40	100			6	4	2.4
8.	BLANK			6	2		1	0.5
9.	20	40	100		4	6		1.6
10.	40-0	40	100		3	7		1.7
11.	BLANK			5	5			0.5
12.	20	40	100	1	3	4	2	1.7
13.	40	40	100		2	3	5	2.3
14.	BLANK			3	7			0.7
15.	20	40	100		2	7	1	1.9
16.	0-(Idle)	0	100		2	3	5	2.3
17.	BLANK			4	6			0.6
18.	0-20	0	100	2		2	6	2.2
19.	40	40	100		1	3	6	2.5
20.	0-20	0	100		1	3	6	2.5
21.	BLANK			5	5			0.5
22.	40	40	100			4	6	2.6

Runs 4, 8, 11, 14, 17, 21 were blank, no exhaust sample.

(1) - (6) See Table 26 for explanation.

TABLE 26C. SERIES 24 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 22, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run	Speed	Load	Dilution	"O" Oily Responses				
No.	MPH	HP	Ratio	0	1	2	3	Average
1.	40-0(5)	40	100		3	7		1.7
2.	20(1)	40	100			9	1	2.1
3.	0-(Idle)(3)	0	100		3	3	4	2.1
4.	BLANK		(6)	5	5			0.5
5.	0-20(4)	0	100		1	5	4	2.3
6.	40-0	40	100		1	5	4	2.3
7.	40(2)	40	100		1	5	4	2.3
8.	BLANK			6	3	1		0.5
9.	20	40	100		3	7		1.7
10.	40-0	40	100		5	5		1.5
11.	BLANK			7	3			0.3
12.	20	40	100		4	5	1	1.4
13.	40	40	100		1	4	5	2.4
14.	BLANK			8	2			0.2
15.	20	40	100	1	2	6	1	1.7
16.	0-(Idle)	0	100		2	4	4	2.2
17.	BLANK			7	3			0.3
18.	0-20	0	100	2	1	3	4	1.9
19.	40	40	100		1	7	2	2.1
20.	0-20	0	100		1	5	4	2.3
21.	BLANK			6	4			0.4
22.	40	40	100		1	3	6	2.5

Runs 4, 8, 11, 14, 17, 21 were blank, no exhaust sample.

(1) - (6) See Table 26 for explanation.

TABLE 26D. SERIES 24 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 22, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"A" Aromatic Responses				
				0	1	2	3	Average
1.	40-0(5)	40	100		7	3		1.3
2.	20(1)	40	100		7	3		1.3
3.	0(Idle)(3)	0	100	2	4	4		1.2
4.	BLANK		(6)	4	6			0.6
5.	0-20(4)	0	100		5	5		1.5
6.	40-0	40	100		8	2		1.2
7.	40(2)	40	100		7	3		1.3
8.	BLANK			8	1	1		0.3
9.	20	40	100		8	2		1.2
10.	40-0	40	100		6	4		1.4
11.	BLANK			4	6			0.6
12.	20	40	100	3	2	5		1.2
13.	40	40	100		3	6	1	1.8
14.	BLANK			10				0
15.	20	40	100		7	3		1.3
16.	0(Idle)	0	100		2	7	1	1.9
17.	BLANK			9	1			0.1
18.	0-20	0	100	1	5	4		1.3
19.	40	40	100		4	5	1	1.7
20.	0-20	0	100		4	5	1	1.7
21.	BLANK			7	1	2		0.3
22.	40	40	100	1	3	5	1	1.6

Runs 4, 8, 11, 14, 17, 21 were blank, no exhaust sample.

(1) - (6) See Table 26 for explanation.

TABLE 26E. SERIES 24 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 22, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"P" Pungent Standard 0	1	2	3	Average
1.	40-0(5)	40	100		8	2		1.2
2.	20(1)	40	100		8	2		1.2
3.	0-(Idle)(3)	0	100		8	2		1.2
4.	BLANK		(6)	5	5			0.5
5.	0-20(4)	0	100		6	3	1	1.5
6.	40-0	40	100	1	5	4		1.3
7.	40(2)	40	100		5	5		1.5
8.	BLANK			9	1			0.1
9.	20	40	100	4	6			0.6
10.	40-0	40	100	2	3	5		1.3
11.	BLANK			9	1			0.1
12.	20	40	100	4	3	3		0.9
13.	40	40	100	1	3	5	1	1.6
14.	BLANK			10				0
15.	20	40	100	3	5	2		0.9
16.	0(Idle)	0	100	1	5	4		1.3
17.	BLANK			7	3			0.3
18.	0-20	0	100	2	5	3		1.1
19.	40	40	100	1	5	4		1.3
20.	0-20	0	100	1	5	4		1.3
21.	BLANK			8	2			0.2
22.	40	40	100		6	4		1.4

Runs 4, 8, 11, 14, 17, 21 were blank, no exhaust sample.

(1) - (6) See Table 26 for explanation.

TABLE 27. SERIES 25 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Mixed Conditions)

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
1.	20(1)	40	100	7	6	6.8	3	1	2.0	2	2	2.0	2	0	1.0	2	0	1.0
8.	20	40	100	7	6	6.6	3	2	1.9	3	1	1.9	2	1	1.5	2	0	1.0
14.	20	40	100	8	6	7.4	3	1	2.5	3	0	1.8	0	0	0	3	0	1.4
20.	20	40	100	8	6	7.1	3	1	2.5	3	1	2.1	3	1	1.8	3	0	1.4
						7.0			2.2			2.0			1.1			1.2
5.	40(2)	40	100	9	7	7.9	4	2	2.8	3	1	2.5	3	1	2.0	3	1	1.5
12.	40	40	100	9	7	7.7	4	2	2.7	3	1	2.3	0	0	0	3	1	1.6
17.	40	40	100	10	7	8.3	4	2	2.8	3	1	2.1	3	1	2.1	3	1	1.8
						8.0			2.8			2.3			1.4			1.6
2.	0(Idle)(3)	0	100	7	5	6.6	3	1	2.0	3	1	2.0	2	1	1.2	2	0	0.9
16.	0(Idle)	0	100	10	6	8.6	4	2	3.2	3	1	2.4	3	2	2.5	3	1	1.7
19.	0(Idle)	0	100	8	4	7.3	3	2	2.5	3	1	2.2	3	1	1.9	3	0	1.4
						7.5			2.6			2.2			1.9			1.3
4.	0-20(4)	0	100	8	7	7.8	3	2	2.8	3	2	2.4	2	1	1.6	3	1	1.4
9.	0-20	0	100	9	7	7.7	3	2	2.4	3	1	2.4	1	0	0.2	3	0	1.4
13.	0-20	0	100	9	6	7.6	4	1	2.6	3	2	2.4	3	0	1.6	2	1	1.4
						7.7			2.6			2.4			1.7			1.4
6.	40-0(5)	40	100	9	7	7.9	4	1	2.5	3	2	2.3	0	0	0	2	0	1.1
11.	40-0	40	100	9	6	8.2	3	2	2.7	3	2	2.5	3	1	1.9	3	0	2.0
18.	40-0	40	100	9	8	8.6	4	2	3.0	3	0	2.3	3	1	2.2	3	1	1.7
						8.2			2.7			2.4			1.4			1.6

TABLE 27. SERIES 25 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Bus 695 - Mixed Conditions)

Run No.	Speed MPH	Load HP	Dilution Ratio	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
3. (6)	0	0	-	3	0	1.6	1	0	0.6	1	0	0.1	0	0	0	1	0	0.1
7.	0	0	-	1	0	0.4	1	0	0.2	1	0	0.2	2	0	1.2	1	0	0.1
10.	0	0	-	3	0	1.3	1	0	0.3	3	0	0.4	3	1	1.9	1	0	0.1
12. A	0	0	-	3	0	0.8	1	0	0.3	2	0	0.2	3	1	1.9	1	0	0.1
15.	0	0	-	3	0	0.9	1	0	0.4	2	0	0.4	3	2	2.5	0	0	0
						1.0			0.4			0.3			1.5			0.1

(1) Constant Speed Condition
(2) Constant Speed Condition
(3) Constant Speed followed by idle Condition
(4) Idle-acceleration, exposure 3 seconds after acceleration
(5) Constant Speed - deceleration, exposure at 23 mph
(6) Runs 3, 7, 10, 12A and 15 were blank runs, no exhaust sample obtained

TABLE 27A. SERIES 25 PROCEDURAL DEVELOPMENT RESULTS
(Diesel "D" Composite Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 23, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run	Speed	Load	Dilution	"D" Composite Responses											
No.	MPH	HP	Ratio	0	1	2	3	4	5	6	7	8	9	10	Average
1.	20(1)	40	100							2	8				6.8
2.	0(Idle)(3)	0	100						1	2	7				6.6
3.	BLANK		(6)	4		2	4								1.6
4.	0-20(4)	0	100								2	8			7.8
5.	40(2)	40	100								3	5	2		7.9
6.	40-0(5)	40	100								3	5	2		7.9
7.	BLANK			6	4										0.4
8.	20	40	100							4	6				6.6
9.	0-20	0	100								4	5	1		7.7
10.	BLANK			3	3	2	2								1.3
11.	40-0	40	100							2		2	6		8.2
12.	40	40	100								4	5	1		7.7
12. A	BLANK			6	1	2	1								0.8
13.	0-20	0	100							1	3	5	1		7.6
14.	20	40	100							1	4	5			7.4
15.	BLANK			6		3	1								0.9
16.	0(Idle)	0	100							1	1		7	1	8.6
17.	40	40	100								3	3	2	2	8.3
18.	40-0	40	100									4	6		8.6
19.	0(Idle)	0	100					1			3	6			7.3
20.	20	20	100							2	5	3			7.1

Runs 3, 7, 10, 12A and 15 were blank runs, no exhaust obtained.

(1) - (6) See Table 27 for explanation.

TABLE 27B. SERIES 25 PROCEDURAL DEVELOPMENT RESULTS
(Burnt "B" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 23, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"B" Burnt Responses					
				0	1	2	3	4	Average
1.	20(1)	40	100		1	8	1		2.0
2.	0(Idle)(3)	0	100		2	6	2		2.0
3.	BLANK		(6)	4	6				0.6
4.	0-20(4)	0	100			2	8		2.8
5.	40(2)	40	100			3	6	1	2.8
6.	40-0(5)	40	100		1	4	4	1	2.5
7.	BLANK			8	2				0.2
8.	20	40	100			8	1		1.9
9.	0-20	0	100			4	6		2.4
10.	BLANK			7	3				0.3
11.	40-0	40	100			3	7		2.7
12.	40	40	100			4	5	1	2.7
12. A	BLANK			7	3				0.3
13.	0-20	0	100		1	3	5	1	2.6
14.	20	40	100		1	3	6		2.5
15.	BLANK			6	4				0.4
16.	0(Idle)	0	100			1	6	3	3.2
17.	40	40	100			3	6	1	2.8
18.	40-0	40	100			2	6	2	3.0
19.	0(Idle)	0	100			5	5		2.5
20.	20	20	100		1	3	6		2.5

Runs 3, 7, 10, 12 A and 15 were blank runs, no exhaust obtained.

(1) - (6) See Table 27 for explanation.

TABLE 27C. SERIES 25 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 23, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run	Speed	Load	Dilution	"O" Oily Responses				
No.	MPH	HP	Ratio	0	1	2	3	Average
1.	20(1)	40	100			10		2.0
2.	0(Idle)(3)	0	100		1	8	1	2.0
3.	BLANK		(6)	9	1			0.1
4.	0-20(4)	0	100			6	4	2.4
5.	40(2)	40	100		1	3	6	2.5
6.	40-0(5)	40	100			7	3	2.3
7.	BLANK			8	2			0.2
8.	20	40	100		3	5	2	1.9
9.	0-20	0	100		2	2	6	2.4
10.	BLANK			8	1		1	0.4
11.	40-0	40	100			5	5	2.5
12.	40	40	100		1	5	4	2.3
12. A	BLANK			9		1		0.2
13.	0-20	0	100			6	4	2.4
14.	20	40	100	1	3	3	3	1.8
15.	BLANK			7	2	1		0.4
16.	0(Idle)	0	100		3	4	3	2.4
17.	40	40	100		2	5	3	2.1
18.	40-0	40	100	1		4	5	2.3
19.	0(Idle)	0	100		1	6	3	2.2
20.	20	20	100		2	5	3	2.1

Runs 3, 7, 10, 12 A and 15 were blank runs, no exhaust obtained.

(1) - (6) See Table 27 for explanation.

TABLE 27D. SERIES 25 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 23, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

Run No.	Speed MPH	Load HP	Dilution Ratio	"A" Aromatic Responses 0	1	2	3	Average
1.	20(1)	40	100	2	6	2		1.0
2.	0(Idle)(3)	0	100		8	2		1.2
3.	BLANK		(6)	10				0
4.	0-20(4)	0	100		4	6		1.6
5.	40(2)	40	100		1	8	1	2.0
6.	40-0(5)	40	100	10				0
7.	BLANK			1	6	3		1.2
8.	20	40	100		5	5		1.5
9.	0-20	0	100	8	2			0.2
10.	BLANK				3	5	2	1.9
11.	40-0	40	100		4	3	3	1.9
12.	40	40	100	10				0
12. A	BLANK				4	3	3	1.9
13.	0-20	0	100	1	4	3	2	1.6
14.	20	40	100	10				0
15.	BLANK					5	5	2.5
16.	0(Idle)	0	100			5	5	2.5
17.	40	40	100		3	3	4	2.1
18.	40-0	40	100		2	4	4	2.2
19.	0(Idle)	0	100		3	5	2	1.9
20.	20	20	100		4	4	2	1.8

Runs 3, 7, 10, 12. A and 15 were blank runs, no exhaust obtained.

(1) - (6) See Table 27 for explanation.

TABLE 27E. SERIES 25 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Bus 695
Sample Method: Constant
Date: December 23, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 1

RUN	Speed	Load	Dilution	"P" Pungent Responses				
No.	MPH	HP	Ratio	0	1	2	3	Average
1.	20(1)	40	100	1	8	1		1.0
2.	0(Idle)(3)	0	100	2	7	1		0.9
3.	BLANK		(6)	9	1			0.1
4.	0-20(4)	0	100		7	2	1	1.4
5.	40(2)	40	100		7	1	2	1.5
6.	40-0(5)	40	100	2	5	3		1.1
7.	BLANK			9	1			0.1
8.	20	40	100	2	6	2		1.0
9.	0-20	0	100	1	5	3	1	1.4
10.	BLANK			9	1			0.1
11.	40-0	40	100	1	1	5	3	2.0
12.	40	40	100		5	4	1	1.6
12. A	BLANK			9	1			0.1
13.	0-20	0	100		6	4		1.4
14.	20	40	100	2	3	4	1	1.4
15.	BLANK			10				0
16.	0(Idle)	0	100		4	5	1	1.7
17.	40	40	100		4	4	2	1.8
18.	40-0	40	100		4	5	1	1.7
19.	0(Idle)	0	100	1	5	3	1	1.4
20.	20	20	100	1	5	3	1	1.4

Runs 3, 7, 10, 12 A and 15 were blank runs, no exhaust obtained.

(1) - (6) See Table 27 for explanation.

APPENDIX D

LABORATORY ODOR AND SMOKE PROCEDURAL DEVELOPMENT RESULTS

(Truck-Tractor Powered by Four-Cycle Diesel Engine)

TABLE 1. PROCEDURAL DEVELOPMENT EXPERIMENTAL SERIES FOR ODOR QUALITY/INTENSITY MEASUREMENT

(Truck-Tractor)

Experimental Series No.	Type of Operation	Speed mph	Load Range hp	Dilution Range
1. (Exploratory)	Constant Speed (Training)	20	0 - 120	500:1 - 5000:1
2. (Exploratory)	Constant Speed	37 and 54	0 - 150	500:1 - 5000:1
3. (Exploratory)	Constant Speed	24 and 42	0 - 160	500:1 - 5000:1
4. (Exploratory)	Idle - Acceleration Acceleration	24 43 - 53	0 - 120	500:1 - 5000:1
5.	Constant Speed	30 and 33	0 - 165	700:1 - 7000:1
6.	Constant Speed-Deceleration	54-0 35-0	0 - 140	700:1 - 7000:1
7.	Constant Speed	21 - 25	0 - 140	700:1 - 7000:1
8.	Constant Speed-Idle	37; 0	0 - 150	700:1 - 7000:1
9. (Training)	Mixed Conditions Idle, Idle-Acceleration, Deceleration, Constant Speed	0 - 35	0 - 160	700:1 - 2000:1
10.	Mixed Conditions Idle, Idle-Acceleration, Deceleration, Constant Speed	0 - 53	0 - 160	700:1 - 2000:1
11.	Mixed Conditions Idle, Idle-Acceleration Deceleration, Constant Speed	0 - 53	0 - 160	700:1 - 2000:1
12.	Mixed Conditions Idle, Idle Acceleration, Deceleration, Constant Speed	0 - 53	0 - 160	700:1 - 2000:1

TABLE 1A. CONSTANT SPEED DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Tentative)

Applicability: Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.

Sample Method: Constant sample flow using a separate orifice for 700:1, 2000:1, and 7000:1 dilution levels; as desired.

Warm-up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.

Vehicle Speeds and Loads: The following are suggested:

Vehicle Speed, mph	Drive Gear	Engine Speed, rpm	Vehicle Load, hp(1)	Power Level
26	7	1700	150	near maximum rack
29	7	1900	150	near maximum rack
33	7	2100	150	near maximum rack

(1) With inertia simulation of 32,000 lbs. of vehicle weight.

Procedure:

(1) Operate at given stable engine and vehicle speed and load.

(2) Turn "on" panel alert light and turn dilution system to "auto" control and continue stable operation.

(3) Ring bell for panel to begin odor evaluation 45 seconds after light is turned "ON" and maintain stable operation.

(4) Panel turns light "off" when evaluation is complete. The evaluation requires 50-70 seconds to complete.

Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with 2 to 3 exposures (sniffs) at will during the approximately 60 second period.

(5) When panel turns "off" light, turn dilution system to "man" control and decelerate.

(6) Wait 3 minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on.")

Run Time: Approximately 3 minutes; with 3 minute rest, 6 minutes

TABLE 1B. IDLE DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Tentative)

Applicability:	Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.
Sample Method:	Constant sample flow using a separate orifice for 700:1, 2000:1, and 7000:1 dilution levels; as desired.
Warm-up:	A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.
Vehicle Speed and Load:	Engine idled at 575 rpm after one minute of operation in 8th gear at 37 mph, 150 hp and 1900 rpm engine speed.
Procedure:	(1) Operate vehicle in 8th gear at 37 mph, engine at 1900 rpm and producing 150 hp at rear wheels for one minute. (2) After one minute of stable operation, closed rack decelerate to 30 mph and shift to neutral and allow engine to idle. (3) Turn "on" panel alert light and turn dilution system to "auto" when vehicle is shifted to neutral and engine is permitted to idle at 575 rpm. (4) Ring bell for panel exposure 30 seconds after beginning of engine idle and continue idle. (5) Panel turns light "off" when evaluation is complete. The evaluations requires 50-70 seconds to complete. Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with 2 to 3 exposures (sniffs) at will during the approximately 60 second period. (6) When panel turns "off" light, turn dilution system to "man" control. (7) Wait 3 minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on".)
Run Time:	Approximately 3 minutes; with 3 minute rest, 6 minutes

TABLE 1C. IDLE-ACCELERATION DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Tentative)

Applicability: Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.

Sample Method: Constant sample flow using a separate orifice for 700:1, 2000:1, and 7000:1 dilution levels; as desired.

Warm-up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.

Inertia Simulation: 32,000 lbs. vehicle weight via SwRI System

Vehicle Speed and Load: Engine idle at 575 rpm followed by normal acceleration from 0 mph to 8 mph in 1st gear with 0 horsepower impressed in water brake dynamometer.

Procedure:

(1) Turn "on" panel alert light, start engine and idle and turn dilution system to "auto".

(2) After one minute of idle, 575 rpm engine speed, accelerate in 1st gear. (Inertia simulation of 32,000 lbs. vehicle weight; 16,000 lbs. per each of two drive axles.) Power is applied gradually essentially as in normal truck operation.

(3) Ring bell as engine speed crosses 1500 rpm on chart recorder (approximately 3 seconds after start of acceleration) for panel exposure.

(4) Continue to accelerate to maximum engine and vehicle speed in 1st gear (2300 rpm and 8 mph), hold for 15 seconds, then shift to neutral and turn "off" engine. Turn "off" light.

(5) Repeat items (1) - (4) above after 2 minute rest. The original and repeat idle-acceleration constitute one run.

(6) Wait 3 minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on".)

NOTE: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with an original and a repeat exposure (sniff).

Run Time: Approximately 4-1/2 minutes; with 3 minute rest, 7 1/2 minutes

TABLE 1D. ACCELERATION DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Tentative)

Applicability:	Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.
Sample Method:	Constant sample flow using a separate orifice for 700:1, 2000:1, and 7000:1 dilution levels; as desired.
Warm-up:	A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.
Inertia Simulation:	32,000 lbs. vehicle weight via SwRI system.
Vehicle Speed and Load:	Full rack acceleration from 43 to 53 mph in 9th gear with 60 hp initially impressed in water brake dynamometer and retained.
Procedure:	(1) Operate in 8th gear at 2200 rpm engine speed, 43 mph, and impress 60 hp into dynamometer. (2) Turn "on" panel alert light and turn dilution system to "auto" control. (3) After 30 seconds of stable operation in 8th gear at 60 hp, upshift to 9th gear and full rack accelerate to 53 mph, load retained in dynamometer. (4) Ring bell for panel exposure on reaching 50 mph. (5) Continue to accelerate in 9th gear to 53 mph, 2200 rpm engine speed, and hold for 15 seconds. (6) Turn "off" light and turn dilution system to "man" and decelerate to a holding condition in 8th gear. (7) Repeat items (1) - (5) above after 2 minute rest. The original and repeat constitute one run. (8) Wait 3 minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on".)

Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with an original and a repeat exposure (sniff).

Run Time: Approximately 5 minutes; with 3 minute rest, 8 minutes

TABLE 1E. CONSTANT SPEED-DECELERATION DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Tentative)

Applicability: Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.

Sample Method: Constant sample flow using a separate orifice for 700:1, 2000:1, and 7000:1 dilution levels; as desired.

Warm-up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.

Inertia Simulation: 32,000 lbs. vehicle weight via SwRI system.

Vehicle Speed and Load: Operate in 9th gear at 2100 rpm engine speed, 52 mph vehicle speed, at open rack, 160 hp, for 1 minute followed by closed rack deceleration with load retained in water brake dynamometer.

Procedure:

(1) Operate in 9th gear at 2100 rpm engine speed and 52 mph vehicle speed at open rack, 160 hp.

(2) Turn "on" panel alert light and turn dilution system to "auto" control.

(3) Continue to operate at stable constant speed conditions for 1 minute and then closed rack decelerate with load retained in water brake dynamometer.

(4) Ring bell for panel exposure 5 seconds after start of closed rack deceleration.

(5) Continue deceleration another 10 seconds and then turn "off" light and turn dilution system to "man" control.

(6) Wait two minutes and repeat items (1) through (6) above. The original and repeat constitute one run.

(7) Wait three minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on".)

Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with an original and a repeat exposure (sniff).

Run Time: Approximately 6 minutes; with 3 minute rest, 8 minutes.

TABLE 2. SERIES 1 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Truck-Tractor - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH(2)	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
1.	500	20	0	5	3	4.4	2	1	1.2	1	1	1.0	1	0	0.7	1	0	0.6
8.	500	20	0	6	3	4.1	2	1	1.2	1	0	0.9	2	0	0.7	1	0	0.2
						4.3			1.2			0.7			0.7			0.4
4.	500	20	120(3)	6	5	5.9	2	2	2.0	2	0	1.5	2	1	1.1	1	0	0.7
7.	500	20	120	6	5	5.3	2	1	1.8	2	0	1.0	1	0	0.9	1	0	0.6
9.	500	20	120	6	4	4.7	2	1	1.5	2	0	1.0	2	0	0.6	1	0	0.5
						5.3			1.8			1.2			0.2			0.6
2.	2000	20	0	3	2	2.4	1	1	1.0	1	0	0.5	1	0	0.4	0	0	0
5.	2000	20	0	4	2	2.4	1	0	0.8	1	0	0.5	1	0	0.3	0	0	0
						2.4			0.4			0.5			0.4			0
3.	2000	20	120	5	3	3.9	2	1	1.3	1	0	0.7	1	0	0.7	0	0	0
6.	2000	20	120	6	3	3.1	2	1	1.2	1	0	0.7	1	0	0.7	0	0	0
						3.5			1.3			0.7			0.7			0
10.	5000	20	120	4	0	2.0	1	0	0.7	1	0	0.2	1	0	0.1	0	0	0

(1) Constant Sampling

(2) Tractor in 6th gear, engine at 1700 rpm.

(3) Open rack, maximum power.

TABLE 2A. SERIES 1 PROCEDURAL DEVELOPMENT RESULTS

(Diesel Composite "D" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 28, 1966

Type Operation: Constant Speed
Vehicle Speed: 20 mph
Fuel: Reference No. 2

All Runs in 6th Gear with Engine at 1700 rpm

Run	Load	Dilution	"D" Composite Responses							
No.(2)	HP	Ratio(1)	0	1	2	3	4	5	6	Ave.
1.	0	500				2	2	6		4.4
2.	0	2000			6	4				2.4
3.	120(3)	2000				2	7	1		3.9
4.	120	500						1	9	5.9
5.	0	2000			7	2	1			2.4
6.	120	2000				2	5	1	2	3.1
7.	120	500						7	3	5.3
8.	0	500				3	4	2	1	4.1
9.	120	500					4	5	1	4.7
10.	120	5000	1	2	4	2	1			2.0

(1) - (3) See Table 2 for explanation.

TABLE 2B. SERIES 1 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 28, 1966

Type Operation: Constant Speed
Vehicle Speed: 20 mph
Fuel: Reference No. 2

All Runs in 6th Gear with Engine at 1700 rpm

Run No. (2)	Load HP	Dilution Ratio (1)	"B" Standard Responses 0	1	2	Average
1.	0	500		8	2	1.2
2.	0	2000		10		1.0
3.	120(3)	2000		7	3	1.3
4.	120	500			10	2.0
5.	0	2000	2	8		0.8
6.	120	2000		8	2	1.2
7.	120	500		2	8	1.8
8.	0	500		8	2	1.2
9.	120	500		5	5	1.5
10.	120	5000	3	7		0.7

TABLE 2C. SERIES 1 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Run No. (2)	Load HP	Dilution Ratio (1)	"O" Oily Standard Responses 0	1	2	Average
1.	0	500		10		1.0
2.	0	2000	5	5		0.5
3.	120(3)	2000	3	7		0.7
4.	120	500	1	3	6	1.5
5.	0	2000	5	5		0.5
6.	120	2000	3	7		0.7
7.	120	500	1	8	1	1.0
8.	0	500	1	9		0.9
9.	120	500	1	8	1	1.0
10.	120	5000	8	2		0.2

(1) - (3) See Table 2 for explanation.

TABLE 3. SERIES 2 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Truck-Tractor - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load Hp	"D" Composite			"B" Smoky			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
3.	500	37(2)	0	5	3	3.6	2	0	1.0	1	0	0.9	1	0	0.2	1	0	0.3
6.	500	37	0	6	4	5.1	2	0	1.4	2	1	1.1	1	0	0.7	1	0	0.4
						4.4			1.2			1.0			0.5			0.4
4.	500	37	150(4)	5	4	4.3	2	1	1.2	1	0	0.9	1	0	0.6	1	0	0.6
10.	500	37	150	6	5	5.8	3	1	2.0	2	1	1.5	2	0	0.9	2	0	1.1
						5.1			1.6			1.2			0.8			0.9
7.	2000	37	0	3	1	2.2	1	0	0.5	1	0	0.9	1	0	0.1	0	0	0
11.	2000	37	0	4	2	3.3	1	0	0.9	1	0	0.9	1	0	0.1	1	0	0.2
						2.8			0.7			0.9			0.1			0.1
5.	2000	37	150	3	2	2.7	1	0	0.7	1	0	0.7	1	0	0.3	1	0	0.1
9.	2000	37	150	3	3	3.0	2	1	1.1	1	0	0.7	1	0	0.3	1	0	0.2
						2.9			0.9			0.7			0.3			0.2
1.	5000	37	0	2	1	1.6	1	0	0.5	1	0	0.5	1	0	0.1	0	0	0
12.	5000	37	0	4	1	2.8	1	0	0.5	1	0	0.9	1	0	0.1	1	0	0.3
						2.2			0.5			0.7			0.1			0.2
2.	5000	37	150	2	1	1.5	1	0	0.3	1	0	0.7	1	0	0.2	0	0	0
8.	5000	37	150	3	1	1.9	1	0	0.6	1	0	0.8	1	0	0.1	0	0	0
						1.7			0.5			0.8			0.2			0
14.	500	54(3)	0	5	3	4.3	2	0	1.4	2	0	1.1	2	0	0.7	1	0	0.3
22.	500	54	0	6	4	5.0	2	2	2.0	2	0	1.2	1	0	0.7	1	0	0.3
						4.7			1.7			1.2			0.7			0.3
13.	500	54	150	6	4	4.9	2	1	1.6	2	1	1.3	2	0	1.0	2	0	0.8
17.	500	54	150	6	4	5.0	2	1	1.6	2	1	1.3	1	0	0.8	1	0	0.5
						5.0			1.6			1.3			0.9			0.7
15.	2000	54	0	4	2	2.8	1	0	0.5	1	0	0.7	1	0	0.4	1	0	0.2
18.	2000	54	0	4	2	3.0	2	0	0.9	1	1	1.0	0	0	0	0	0	0
						2.9			0.7			0.9			0.2			0.1
19.	2000	54	150	4	1	2.5	1	0	0.7	1	0	0.9	2	0	0.2	1	0	0.2
24.	2000	54	150	3	3	3.0	1	1	1.0	1	0	0.9	1	0	0.2	1	0	0.1
						2.8			0.8			0.9			0.2			0.2

TABLE 3. SERIES 2 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Truck-Tractor - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Smoky Max.	"B" Smoky Min.	"B" Smoky Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
20.	5000	54	0	2	1	1.4	2	0	0.8	1	0	0.7	1	0	0.1	0	0	0
23.	5000	54	0	4	1	2.0	1	0	0.7	1	0	0.8	1	0	0.2	0	0	0
						1.7			0.8			0.9			0.2			0
16.	5000	54	150	4	3	3.7	2	0	1.1	1	0	0.9	1	0	0.4	0	0	0
21.	5000	54	150	4	3	3.3	2	1	1.2	1	0	0.9	1	0	0.2	1	0	0.1
						3.5			1.2			0.9			0.3			0.1

(1) Constant Sampling

(2) Runs 1-12 at 37 mph in 8th gear, engine at 1900 rpm.

(3) Runs 13-24 at 54 mph in 9th gear, engine at 2200 rpm.

(4) Open Rack, maximum power.

TABLE 2D. SERIES 1 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 28, 1966

Type Operation: Constant Speed
Vehicle Speed: 20 mph
Fuel: Reference No. 2

All runs in 6th gear with Engine at 1700 rpm

Run (2)	Load	Dilution	"A" Standard Responses			
No	HP	Ratio(1)	0	1	2	Average
1.	0	500	3	7		0.7
2.	0	2000	6	4		0.4
3.	120(3)	2000	3	7		0.7
4.	120	500		9	1	1.1
5.	0	2000	7	3		0.3
6.	120	2000	3	7		0.7
7.	120	500	1	9		0.9
8.	0	500	4	5	1	0.7
9.	120	500	5	4	1	0.6
10.	120	5000	9	1		0.1

TABLE 2E. SERIES 1 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Run	Load	Dilution	"P" Standard Responses			
No.(2)	Hp	Ratio(1)	0	1	2	Average
1.	0	500	4	6		0.6
2.	0	2000	10			0
3.	120(3)	2000	10			0
4.	120	500	3	7		0.7
5.	0	2000	10			0
6.	120	2000	10			0
7.	120	500	4	6		0.6
8.	0	500	8	2		0.2
9.	120	500	5	5		0.5
10	120	5000	10			0

(1) - (3) See Table 2 for explanation.

TABLE 3A. SERIES 2 PROCEDURAL DEVELOPMENT RESULTS

(Diesel Composite "D" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 29, 1966

Type Operation: Constant Speed
Vehicle Speeds: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Responses 1	2	3	4	5	6	Ave.
1.	37(2)	0	5000	4	6					1.6
2.	37	150(4)	5000	5	5					1.5
3.	37	0	500			5	4	1		3.6
4.	37	150	500				7	3		4.3
5.	37	150	2000		3	7				2.7
6.	37	0	500				3	3	4	5.1
7.	37	0	2000	2	4	4				2.2
8.	37	150	5000	3	5	2				1.9
9.	37	150	2000			10				3.0
10.	37	150	500					2	8	5.8
11.	37	0	2000		2	3	5			3.3
12.	37	0	5000	2		6	2			2.8
13.	54(3)	150	500				4	3	3	4.9
14.	54	0	500			3	1	6		4.3
15.	54	0	2000		5	2	3			2.8
16.	54	150	5000			3	7			3.7
17.	54	150	500				2	6	2	5.0
18.	54	0	2000		2	6	2			3.0
19.	54	150	2000	1	6		3			2.5
20.	54	0	5000	6	4					1.4
21.	54	150	5000			7	4			3.3
22.	54	0	500				2	6	2	5.0
23.	54	0	5000	4	3	2	1			2.0
24.	54	150	2000			10				3.0

(1) - (4) See Table 3 for explanation.

TABLE 3B. SERIES 2 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 29, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"B" Standard Responses				
				0	1	2	3	Ave.
1.	37(2)	0	5000	5	5			0.5
2.	37	150(4)	5000	7	3			0.3
3.	37	0	500	1	8	1		1.0
4.	37	150	500		8	2		1.2
5.	37	150	2000	3	7			0.7
6.	37	0	500	1	4	5		1.4
7.	37	0	2000	5	5			0.5
8.	37	150	5000	4	6			0.6
9.	37	150	2000		9	1		1.1
10.	37	150	500		1	8	1	2.0
11.	37	0	2000	1	9			0.9
12.	37	0	5000	5	5			0.5
13.	54(3)	150	500		4	6		1.6
14.	54	0	500	1	4	5		1.4
15.	54	0	2000	5	5			0.5
16.	54	150	5000	2	5	3		1.1
17.	54	150	500		4	6		1.6
18.	54	0	2000	1	8	1		0.9
19.	54	150	2000	3	7			0.7
20.	54	0	5000	3	6	1		0.8
21.	54	150	5000		8	2		1.2
22.	54	0	500			10		2.0
23.	54	0	5000	3	7			0.7
24.	54	150	2000		10			1.0

(1) - (4) See Table 3 for explanation.

TABLE 3C. SERIES 2 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 29, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"O" Standard Responses 0	1	2	Average
1.	37(2)	0	5000	5	5		0.5
2.	37	150(4)	5000	3	7		0.7
3.	37	0	500	1	9		0.9
4.	37	150	500	1	9		0.9
5.	37	150	2000	3	7		0.7
6.	37	0	500		9	1	1.1
7.	37	0	2000	1	9		0.9
8.	37	150	5000	2	8		0.8
9.	37	150	2000	3	7		0.7
10.	37	150	500		5	5	1.5
11.	37	0	2000	1	9		0.9
12.	37	0	5000	1	9		0.9
13.	54(3)	150	500		7	3	1.3
14.	54	0	500	1	7	2	1.1
15.	54	0	2000	3	7		0.7
16.	54	150	5000	1	9		0.9
17.	54	150	500		7	3	1.3
18.	54	0	2000		10		1.0
19.	54	150	2000	1	9		0.9
20.	54	0	5000	3	7		0.7
21.	54	150	5000	1	9		0.9
22.	54	0	500		8	2	1.2
23.	54	0	5000	2	8		0.8
24.	54	150	2000	1	9		0.9

(1) - (4) See Table 3 for explanation.

TABLE 3D. SERIES 2 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 29, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run	Speed	Load	Dilution	"A" Standard Responses			
No.	MPH	HP	Ratio(1)	0	1	2	Ave.
1.	37(2)	0	5000	9	1		0.1
2.	37	150(4)	5000	8	2		0.2
3.	37	0	500	8	2		0.2
4.	37	150	500	4	6		0.6
5.	37	150	2000	7	3		0.3
6.	37	0	500	3	7		0.7
7.	37	0	2000	9	1		0.1
8.	37	150	5000	9	1		0.1
9.	37	150	2000	7	3		0.3
10.	37	150	500	2	7	1	0.9
11.	37	0	2000	9	1		0.1
12.	37	0	5000	9	1		0.1
13.	54(3)	150	500	1	8	1	1.0
14.	54	0	500	4	5	1	0.7
15.	54	0	2000	6	4		0.4
16.	54	150	5000	6	4		0.4
17.	54	150	500	3	6	1	0.8
18.	54	0	2000	10			0
19.	54	150	2000	9		1	0.2
20.	54	0	5000	9	1		0.1
21.	54	150	5000	8	2		0.2
22.	54	0	500	3	7		0.7
23.	54	0	5000	8	2		0.2
24.	54	150	2000	8	2		0.2

(1) - (4) See Table 3 for explanation.

TABLE 3E. SERIES 2 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 29, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"P" Standard Responses			
				0	1	2	Ave.
1.	37(2)	0	5000	10			0
2.	37	150(4)	5000	10			0
3.	37	0	500	7	3		0. 3
4.	37	150	500	4	6		0. 6
5.	37	150	2000	9	1		0. 1
6.	37	0	500	6	4		0. 4
7.	37	0	2000	10			0
8.	37	150	5000	10			0
9.	37	150	2000	8	2		0. 2
10.	37	150	500	1	7	2	1. 1
11.	37	0	2000	8	2		0. 2
12.	37	0	5000	7	3		0. 3
13.	54(3)	150	500	3	6	1	0. 8
14.	54	0	500	7	3		0. 3
15.	54	0	2000	8	2		0. 2
16.	54	150	5000	10			0
17.	54	150	500	5	5		0. 5
18.	54	0	2000	10			0
19.	54	150	2000	8	2		0. 2
20.	54	0	5000	10			0
21.	54	150	5000	9	1		0. 1
22.	54	0	500	7	3		0. 3
23.	54	0	5000	10			0
24.	54	150	2000	9	1		0. 1

(1) - (4) See Table 3 for explanation.

TABLE 4. SERIES 3 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Truck-Tractor - Constant Speed)

Run	Dilution	Speed	Load	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
No.	Ratio(1)	MPH	HP	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
5.	500	24(2)	0	4	2	3.4	2	0	1.0	1	0	0.9	1	0	0.4	1	0	0.4
8.	500	24	0	6	3	4.7	2	1	1.3	2	0	1.2	1	0	0.7	1	0	0.4
						4.1			1.2			1.1			0.6			0.4
2.	500	24	150(4)	6	5	5.5	2	1	1.7	2	1	1.2	1	0	0.6	1	0	0.8
11.	500	24	150	4	2	3.4	2	0	0.8	1	0	0.7	1	0	0.6	1	0	0.4
						4.5			1.3			1.0			0.6			0.6
4.	2000	24	0	4	1	2.9	2	0	0.7	1	0	0.8	1	0	0.7	1	0	0.2
12.	2000	24	0	4	1	2.6	1	0	0.6	1	0	0.8	1	0	0.1	1	0	0.1
						2.8			0.7			0.8			0.4			0.2
6.	2000	24	150	5	4	4.3	2	1	1.4	2	0	1.1	1	0	0.5	1	0	0.5
9.	2000	24	150	3	2	2.3	1	0	0.9	1	0	0.9	1	0	0.4	1	0	0.1
						3.3			1.2			1.0			0.5			0.3
1.	5000	24	0	2	1	1.5	1	0	0.3	1	0	0.9	1	0	0.1	0	0	0
10.	5000	24	0	3	1	2.0	1	0	0.6	1	0	0.6	1	0	0.3	0	0	0
						1.8			0.5			0.8			0.2			0
3.	5000	24	150	4	1	3.6	2	0	1.1	1	0	0.9	1	0	0.4	1	0	0.5
7.	5000	24	150	5	4	4.6	2	1	1.3	2	0	1.2	1	0	0.6	1	0	0.5
						4.1			1.2			1.1			0.5			0.5
18.	500	42(3)	0	6	4	5.2	2	1	1.7	2	1	1.1	2	0	0.7	1	0	0.3
19.	500	42	0	5	3	4.0	2	1	1.1	1	1	1.0	1	0	0.8	1	0	0.2
						4.6			1.4			1.1			0.8			0.3
13.	500	42	150	5	4	4.7	2	0	1.1	1	0	0.7	2	1	1.4	1	0	0.4
15.	500	42	160(5)	6	5	5.8	2	1	1.1	2	0	1.7	2	0	0.9	1	0	0.6
17.	5000	42	0	3	1	2.2	1	0	0.6	2	0	0.8	2	0	0.4	1	0	0.1
14.	5000	42	160	5	1	3.3	2	0	0.9	1	0	0.6	1	0	0.4	1	0	0.4
16.	5000	42	160	4	2	2.7	1	0	0.8	1	0	0.5	1	0	0.6	1	0	0.1
						3.0			0.9			0.6			0.5			0.3

(1) Constant Sampling

(2) Runs 1-12 at 24 mph in 7th gear, engine at 1500 rpm

(3) Runs 13-19 at 42 mph in 8th gear, engine at 2100 rpm

(4) Open rack, maximum power

(5) Open rack, maximum power

TABLE 4A. SERIES 3 PROCEDURAL DEVELOPMENT RESULTS
(Diesel "D" Composite Standard)

Vehicle: Truck-Tractor	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: See Below
Date: November 30, 1966	Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Responses 1	2	3	4	5	6	Ave.
1.	24(2)	0	5000	5	5					1.5
2.	24	150(4)	500					5	5	5.5
3.	24	150	5000	1		1	8			3.6
4.	24	0	2000	1	3	2	4			2.9
5.	24	0	500		2	2	6			3.4
6.	24	150	2000				7	3		4.3
7.	24	150	5000				4	6		4.6
8.	24	0	500			1	3	4	2	4.7
9.	24	150	2000		7	3				2.3
10.	24	0	5000	2	6	2				2.0
11.	24	150	500		1	4	5			3.4
12.	24	0	2000	2	1	6	1			2.6
13.	42(3)	150	500				3	7		4.7
14.	42	160(5)	5000	2	1	2	2	3		3.3
15.	42	160	500					2	8	5.8
16.	42	160	5000		5	3	2			2.7
17.	42	0	5000	2	4	4				2.2
18.	42	0	500				2	4	4	5.2
19.	42	0	500			4	2	4		4.0

(1) - (5) See Table 4 for explanation.

TABLE 4B. SERIES 3 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: See Below
Date: November 30, 1966	Fuel: Reference No. 2

Run	Speed	Load	Dilution	"B" Standard Responses				
No.	MPH	HP	Ratio(1)	0	1	2	3	Ave.
1.	24(2)	0	5000	7	3			0.3
2.	24	150(4)	500		3	7		1.7
3.	24	150	5000	1	7	2		1.1
4.	24	0	2000	4	5	1		0.7
5.	24	0	500	1	8	1		1.0
6.	24	150	2000		6	4		1.4
7.	24	150	5000		7	3		1.3
8.	24	0	500		7	3		1.3
9.	24	150	2000	1	9			0.9
10.	24	0	5000	4	6			0.6
11.	24	150	500	3	6	1		0.8
12.	24	0	2000	4	6			0.6
13.	42(3)	150	500	2	5	3		1.1
14.	42	160(5)	5000	3	5	2		0.9
15.	42	160	500		9	1		1.1
16.	42	160	5000	2	8			0.8
17.	42	0	5000	4	6			0.6
18.	42	0	500		3	7		1.7
19.	42	0	500		9	1		1.1

(1) - (5) See Table 4 for explanation.

TABLE 4C. SERIES 3 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 30, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"O" Standard Responses 0	1	2	Average
1.	24(2)	0	5000	1	9		0.9
2.	24	150(4)	500		8	2	1.2
3.	24	150	5000	1	9		0.9
4.	24	0	2000	2	8		0.8
5.	24	0	500	1	9		0.9
6.	24	150	2000	1	7	2	1.1
7.	24	150	5000	1	6	3	1.2
8.	24	0	500	1	6	3	1.2
9.	24	150	2000	1	9		0.9
10.	24	0	5000	4	6		0.6
11.	24	150	500	3	7		0.7
12.	24	0	2000	2	8		0.8
13.	42(3)	150	500	3	7		0.7
14.	42	160(5)	5000	4	6		0.6
15.	42	160	500	1	1	8	1.7
16.	42	160	5000	5	5		0.5
17.	42	0	5000	3	6	1	0.8
18.	42	0	500		9	1	1.1
19.	42	0	500		10		1.0

(1) - (5) See Table 4 for explanation.

TABLE 4D. SERIES 3 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: See Below
Date: November 30, 1966	Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"A" Standard Responses 0	1	2	Average
1.	24(2)	0	5000	9	1		0.1
2.	24	150(4)	500	4	6		0.6
3.	24	150	5000	6	4		0.4
4.	24	0	2000	3	7		0.7
5.	24	0	500	6	4		0.4
6.	24	150	2000	5	5		0.5
7.	24	150	5000	4	6		0.6
8.	24	0	500	3	7		0.7
9.	24	150	2000	6	4		0.4
10.	24	0	5000	7	3		0.3
11.	24	150	500	4	6		0.6
12.	24	0	2000	9	1		0.1
13.	42(3)	150	500		6	4	1.4
14.	42	160(5)	5000	6	4		0.4
15.	42	160	500	2	7	1	0.9
16.	42	160	5000	4	6		0.6
17.	42	0	5000	7	2	1	0.4
18.	42	0	500	4	5	1	0.7
19.	42	0	500	2	8		0.8

(1) - (5) See Table 4 for explanation.

TABLE 4E. SERIES 3 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: November 30, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"P" Standard Responses		
				0	1	Average
1.	24(2)	0	5000	10		0
2.	24	150(4)	500	2	8	0.8
3.	24	150	5000	5	5	0.5
4.	24	0	2000	8	2	0.2
5.	24	0	500	6	4	0.4
6.	24	150	2000	5	5	0.5
7.	24	150	5000	5	5	0.5
8.	24	0	500	6	4	0.4
9.	24	150	2000	9	1	0.1
10.	24	0	5000	10		0
11.	24	150	500	6	4	0.4
12.	24	0	2000	9	1	0.1
13.	42(3)	150	500	6	4	0.4
14.	42	160(5)	5000	6	4	0.4
15.	42	160	500	4	6	0.6
16.	42	160	5000	9	1	0.1
17.	42	0	5000	9	1	0.1
18.	42	0	500	7	3	0.3
19.	42	0	500	8	2	0.2

(1) - (5) See Table 4 for explanation.

TABLE 5. SERIES 4 PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(Truck-Tractor - Idle-Acceleration)

Run No.(1)	Dilution Ratio	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
1.	500	55	0	6	4	4.8	2	1	1.8	2	1	1.2	2	0	0.8	1	0	0.5
5.	500	55	0	6	5	5.2	2	1	1.3	2	0	1.1	2	0	1.0	1	0	0.7
6.	500	55	0	6	4	4.9	2	1	1.5	2	0	1.0	2	0	0.9	1	0	0.7
8.	500	55	0	7	5	5.7	2	2	2.0	2	1	1.3	1	0	0.8	2	0	0.9
10.	500	55	0	6	5	6.3	3	1	1.9	2	1	1.2	2	0	1.0	1	0	0.8
						5.4			1.7			1.2			0.9			0.7
2.	2000	55	0	4	2	3.2	2	1	1.1	1	0	0.6	1	0	0.3	0	0	0
7.	2000	55	0	2	1	1.6	1	0	0.7	1	0	0.6	1	0	0.7	0	0	0
						2.4			0.9			0.6			0.5			0
3.	5000	55	0	3	1	2.0	1	0	0.5	1	0	0.6	1	0	0.4	0	0	0
4.	5000	55	0	2	1	1.6	1	0	0.5	1	0	0.7	1	0	0.3	1	0	0.1
9.	5000	55	0	3	1	1.8	1	0	0.5	1	0	0.3	1	0	0.6	1	0	0.1
						1.8			0.5			0.5			0.4			0
11. a. (2)	500	45	60(4)	5	4	4.7	2	1	1.4	2	1	1.3	1	0	0.7	1	0	0.7
13. a.	500	45	60	5	4	4.6	2	1	1.2	2	0	1.0	1	1	1.0	1	0	0.5
16. a.	500	45	60	6	4	4.9	2	1	1.6	2	0	1.2	2	0	0.9	1	0	0.2
						4.7			1.4			1.2			0.9			0.5
11. b. (3)	500	53	120(5)	5	2	4.1	2	1	1.2	2	1	1.1	1	0	0.9	1	0	0.5
13. b.	500	53	120	6	5	5.1	2	1	1.3	2	0	1.1	2	0	0.9	1	0	0.6
16. b.	500	53	120	6	3	5.7	3	1	1.8	2	0	1.2	2	0	1.2	1	0	0.2
						5.0			1.4			1.1			1.0			0.6
14. a.	2000	45	60	2	1	1.8	1	0	0.4	1	0	0.5	1	0	0.4	0	0	0
15. a.	2000	45	60	3	1	2.1	1	0	0.7	1	0	0.6	1	0	0.2	0	0	0
						2.0			0.6			0.6			0.3			0
14. b.	2000	53	120	3	1	1.7	1	0	0.5	1	0	0.6	1	0	0.3	0	0	0
15. b.	2000	53	120	2	1	1.8	1	0	0.6	1	0	0.5	1	0	0.2	1	0	0.2
						1.8			0.6			0.6			0.3			0.1
12. a.	5000	45	60	2	1	1.7	1	0	0.5	1	0	0.5	1	0	0.6	1	0	0.2
17. a	5000	45	60	3	1	1.8	1	0	0.7	1	0	0.5	1	0	0.4	0	0	0
						1.8			0.6			0.5			0.5			0.1

TABLE 5. SERIES 4 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Truck-Tractor - Idle-Acceleration)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
12.b.	5000	53	120	2	1	1.7	1	0	0.4	1	0	0.5	1	0	0.3	1	0	0.2
17.b.	5000	53	120	2	1	1.8	1	0	0.4	1	0	0.7	1	0	0.2	0	0	0
						1.8			0.4			0.6			0.3			0.1

(1) Runs 1-10 in first gear at full rack acceleration with evaluations made at 3 seconds after start of acceleration as engine speed crossed 1500 rpm (5.5 mph)

Runs 11-17 in eight gear at 2200 rpm for 30 seconds, upshift to 9th gear full rack acceleration to 2200 rpm

(2) Exposure "a" at 3 seconds after upshift from eighth gear (43 mph) and acceleration

(3) Exposure "b" on reaching 2200 rpm engine speed at 53 mph

(4) Impressed in dynamometer at 43 mph (8th gear, 2200 rpm engine speed)

(5) Read at "b" exposure

TABLE 5A. SERIES 4 PROCEDURAL DEVELOPMENT RESULTS
(Diesel "D" Composite Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 1, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: See Below
Fuel: Reference No. 2

Run	Speed	Load	Dilution	"D" Composite Responses							
No. (1)	MPH	HP	Ratio	1	2	3	4	5	6	7	Ave.
1.	5.5	0	500				3	6	1		4.8
2.	5.5	0	2000		1	6	3				3.2
3.	5.5	0	5000	1	8	1					2.0
4.	5.5	0	5000	4	6						1.6
5.	5.5	0	500					8	2		5.2
6.	5.5	0	500				2	7	1		4.9
7.	5.5	0	2000	4	6						1.6
8.	5.5	0	500					5	3	2	5.7
9.	5.5	0	5000	3	6	1					1.8
10.	5.5	0	500					3	7		6.3
11.a. (2)	45	60(4)	500				3	7			4.7
b. (3)	53	120(5)	500		1	1	4	4			4.1
12.a.	45	60	5000	3	7						1.7
b.	53	120	5000	3	7						1.7
13.a.	45	60	500				4	6			4.6
b.	53	120	500					9	1		5.1
14.a.	45	60	2000	2	8						1.8
b.	53	120	2000	4	5	1					1.7
15.a.	45	60	2000	2	5	3					2.1
b.	53	120	2000	2	8						1.8
16.a.	45	60	500				2	7	1		4.9
b.	53	120	500			1		6	3		5.7
17.a.	45	60	5000	3	6	1					1.8
b.	53	120	5000	4	6						1.8

(1) - (5) See Table 5 for explanation.

TABLE 5B. SERIES 4 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 1, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No. (1)	Speed MPH	Load HP	Dilution Ratio	"B" Standard Responses				
				0	1	2	3	Ave.
1.	5.5	0	500		2	8		1.8
2.	5.5	0	2000		9	1		1.1
3.	5.5	0	5000	5	5			0.5
4.	5.5	0	5000	5	5			0.5
5.	5.5	0	500		7	3		1.3
6.	5.5	0	500		5	5		1.5
7.	5.5	0	2000	3	7			0.7
8.	5.5	0	500			10		2.0
9.	5.5	0	5000	5	5			0.5
10.	5.5	0	500		2	7	1	1.9
11. a.(2)	45	60(4)	500		6	4		1.4
b.(3)	53	120(5)	500		8	2		1.2
12. a.	45	60	5000	5	5			0.5
b.	53	120	5000	6	4			0.4
13. a.	45	60	500		8	2		1.2
b.	53	120	500		7	3		1.3
14. a.	45	60	2000	6	4			0.4
b.	53	120	2000	5	5			0.5
15. a.	45	60	2000	3	7			0.7
b.	53	120	2000	4	6			0.6
16. a.	45	60	500		4	6		1.6
b.	53	120	500		3	6	1	1.8
17. a.	45	60	5000	3	7			0.7
b.	53	120	5000	6	4			0.4

(1) - (5) See Table 5 for explanation.

TABLE 5C. SERIES 4 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 1, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: See Below
Fuel: Reference No. 2

Run	Speed	Load	Dilution	"O" Standard Responses			
No.(1)	MPH	Hp	Ratio	0	1	2	Ave.
1.	5.5	0	500		8	2	1.2
2.	5.5	0	2000	4	6		0.6
3.	5.5	0	5000	4	6		0.6
4.	5.5	0	5000	3	7		0.7
5.	5.5	0	500	1	7	2	1.1
6.	5.5	0	500	2	6	2	1.0
7.	5.5	0	2000	4	6		0.6
8.	5.5	0	500		7	3	1.3
9.	5.5	0	5000	7	3		0.3
10.	5.5	0	500		8	2	1.2
11. a. (2)	45	60(4)	500		7	3	1.3
b. (3)	53	120(5)	500		9	1	1.1
12. a.	45	60	5000	5	5		0.5
b.	53	120	5000	5	5		0.5
13. a.	45	60	500	2	6	2	1.0
b.	53	120	500	1	7	2	1.1
14. a.	45	60	2000	5	5		0.5
b.	53	120	2000	4	6		0.6
15. a.	45	60	2000	4	6		0.6
b.	53	120	2000	5	5		0.5
16. a.	45	60	500	2	4	4	1.2
b.	53	120	500	2	4	4	1.2
17. a.	45	60	5000	6	3	1	0.5
b.	53	120	5000	3	7		0.7

(1) - (5) See Table 5 for explanation.

TABLE 5D. SERIES 4 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 1, 1966

Type Operation: Idle-Acceleration
Vehicle Speed: See below
Fuel: Reference No. 2

Run No.(1)	Speed MPH	Load HP	Dilution Ratio	"A" Standard Responses 0	1	2	Average
1.	5.5	0	500	3	6	1	0.8
2.	5.5	0	2000	7	3		0.3
3.	5.5	0	5000	6	4		0.4
4.	5.5	0	5000	7	3		0.3
5.	5.5	0	500	1	8	1	1.0
6.	5.5	0	500	2	7	1	0.9
7.	5.5	0	2000	3	7		0.7
8.	5.5	0	500	2	8		0.8
9.	5.5	0	5000	4	6		0.6
10.	5.5	0	500	1	8	1	1.0
11. a. (2)	45	60(4)	500	3	7		0.7
b. (3)	53	120(5)	500	1	9		0.9
12. a.	45	60	5000	4	6		0.6
b.	53	120	5000	7	3		0.3
13. a.	45	60	500		10		1.0
b.	53	120	500	1	7	2	0.9
14. a.	45	60	2000	6	4		0.4
b.	53	120	2000	7	3		0.3
15. a.	45	60	2000	8	2		0.2
b.	53	120	2000	8	2		0.2
16. a.	45	60	500	2	7	1	0.9
b.	53	120	500	1	6	3	1.2
17. a.	45	60	5000	6	4		0.4
b.	53	120	5000	8	2		0.2

(1) - (5) See Table 5 for explanation.

TABLE 5E. SERIES 4 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor	Type Operation: Idle-Acceleration
Sample Method: Constant	Vehicle Speed: See below
Date: December 1, 1966	Fuel: Reference No. 2

Run No. (1)	Speed MPH	Load HP	Dilution Ratio	"P" Standard Responses 0	1	2	Average
1.	5.5	0	500	5	5		0.5
2.	5.5	0	2000	10			0
3.	5.5	0	5000	10			0
4.	5.5	0	5000	9	1		0.1
5.	5.5	0	500	3	7		0.7
6.	5.5	0	500	3	7		0.7
7.	5.5	0	2000	10			0
8.	5.5	0	500	2	7	1	0.9
9.	5.5	0	5000	9	1		0.1
10.	5.5	0	500	2	8		0.8
11. a. (2)	45	60(4)	500	3	7		0.7
b. (3)	53	120(5)	500	5	5		0.5
12. a.	45	60	5000	8	2		0.2
b.	53	120	5000	8	2		0.2
13. a.	45	60	500	5	5		0.5
b.	53	120	500	4	6		0.6
14. a.	45	60	2000	10			0
b.	53	120	2000	10			0
15. a.	45	60	2000	10			0
b.	53	120	2000	8	2		0.2
16. a.	45	60	500	8	2		0.2
b.	53	120	500	8	2		0.2
17. a.	45	60	5000	10			0
b.	53	120	5000	10			0

(1) - (5) See Table 5 for explanation.

TABLE 6. SERIES 5 PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(Truck-Tractor - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
8.	700	30(2)	0	4	1	2.8	1	0	0.9	1	0	0.9	1	0	0.2	1	0	0.1
10.	700	30	0	3	1	2.5	1	0	0.8	1	0	0.8	1	0	0.3	0	0	0
						2.7			0.9			0.9			0.3			0
3.	700	30	140(4)	4	3	3.3	1	0	0.9	1	0	0.9	1	0	0.4	1	0	0.5
6.	700	30	140	4	2	2.6	1	0	0.8	1	0	0.6	1	0	0.4	1	0	0.3
						3.0			0.9			0.8			0.4			0.4
4.	2000	30	0	3	2	2.5	1	0	0.9	1	0	0.6	1	0	0.4	1	0	0.1
5.	2000	30	0	3	1	2.2	1	0	0.5	1	0	0.7	1	0	0.1	1	0	0.3
						2.4			0.7			0.7			0.3			0.2
7.	2000	30	140	3	1	1.9	1	0	0.4	1	0	0.6	1	0	0.3	1	0	0.6
12.	2000	30	140	5	1	2.8	1	0	0.8	1	0	0.8	1	0	0.6	1	0	0.3
						2.4			0.6			0.7			0.5			0.5
1.	7000	30	0	2	1	1.6	1	0	0.7	1	0	0.7	0	0	0	0	0	0
11.	7000	30	0	3	1	2.0	1	0	0.6	1	0	0.8	1	0	0.4	1	0	0.1
						1.8			0.7			0.8			0.2			0
2.	7000	30	140	3	1	1.5	1	0	0.5	1	0	0.5	1	0	0.4	0	0	0
9.	7000	30	140	2	1	1.2	1	0	0.5	1	0	0.5	1	0	0.3	0	0	0
						1.4			0.5			0.5			0.4			0
14.	700	33(3)	0	4	3	3.6	2	0	1.0	1	0	0.9	1	0	0.7	0	0	0
18.	700	33	0	6	4	4.9	3	1	1.5	2	0	0.7	1	0	0.7	1	0	0
						4.3			1.3			0.8			0.7			0
17.	700	33	165(5)	4	3	3.9	2	1	1.2	1	0	0.8	2	0	1.0	1	0	0.7
22.	700	33	165	5	4	4.4	3	1	1.2	1	0	1.0	1	0	0.9	1	0	0.5
						4.2			1.2			0.9			1.0			0.6
21.	2000	33	0	3	1	1.9	1	0	0.8	1	0	0.7	1	0	0.2	0	0	0
24.	2000	33	0	4	2	3.0	2	0	0.9	1	0	0.7	1	0	0.6	1	0	0.5
						2.5			0.9			0.7			0.4			0.3

TABLE 6. SERIES 5 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Truck-Tractor - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
15.	2000	33	165	3	1	1.7	1	0	0.7	1	0	0.7	1	0	0.1	1	0	0.5
23.	2000	33	165	3	2	2.7	1	0	0.9	1	0	0.6	1	0	0.3	1	0	0.2
						2.2			0.8			0.7			0.2			0.4
19.	7000	33	0	3	1	1.5	1	0	0.4	1	0	0.7	1	0	0.2	0	0	0
20.	7000	33	0	3	1	1.7	1	0	0.8	1	0	0.6	1	0	0.2	0	0	0
						1.6			0.6			0.7			0.2			0
13.	7000	33	165	2	1	1.5	1	0	0.5	1	0	0.8	1	0	0.2	1	0	0.4
16.	7000	33	165	3	1	1.8	1	0	0.6	1	0	0.7	1	0	0.4	1	0	0.1
25.	7000	33	165	4	2	2.8	2	0	1.0	1	0	0.9	1	0	0.3	1	0	0.2
						2.0			0.7			0.8			0.3			0.3

(1) Constant Sampling

(2) Runs 1-12 all in 8th gear at 30 mph, engine speed of 1500 rpm

(3) Runs 13-24 all in 7th gear at 33 mph, engine speed of 2100 rpm

(4) Open rack - maximum power

(5) Open rack - maximum power

TABLE 6A. SERIES 5 PROCEDURAL DEVELOPMENT RESULTS
(Diesel "D" Composite Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 2, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Responses						
				1	2	3	4	5	6	Ave.
1.	30(2)	0	7000	4	6					1. 6
2.	30	140(4)	7000	6	3	1				1. 5
3.	30	140	700			7	3			3. 3
4.	30	0	2000		5	5				2. 5
5.	30	0	2000	1	5	4				2. 2
6.	30	140	700		6	2	2			2. 6
7.	30	140	2000	3	5	2				1. 9
8.	30	0	700		3	6	1			2. 8
9.	30	140	7000	8	2					1. 2
10.	30	0	700	1	4	5				2. 5
11.	30	0	7000	3	4	3				2. 0
12.	30	140	2000	2	3	2	1	2		2. 8
13.	33(3)	165(5)	7000	5	5					1. 5
14.	33	0	700			4	6			3. 6
15.	33	165	2000	4	5	1				1. 7
16.	33	165	7000	5	2	3				1. 8
17.	33	165	700			1	9			3. 9
18.	33	0	700				3	5	2	4. 9
19.	33	0	7000	6	3	1				1. 5
20.	33	0	7000	4	5	1				1. 7
21.	33	0	2000	4	3	3				1. 9
22.	33	165	700				6	4		4. 4
23.	33	165	2000		3	7				2. 7
24.	33	0	2000		3	4	3			3. 0
25.	33	165	7000		3	6	1			2. 8

(1) - (5) See Table 6 for explanation.

TABLE 6B. SERIES 5 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 2, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"B" Standard Responses				
				0	1	2	3	Ave.
1.	30(2)	0	7000	3	7			0.7
2.	30	140(4)	7000	5	5			0.5
3.	30	140	700	1	9			0.9
4.	30	0	2000	1	9			0.9
5.	30	0	2000	5	5			0.5
6.	30	140	700	2	8			0.8
7.	30	140	2000	6	4			0.4
8.	30	0	700	1	9			0.9
9.	30	140	7000	5	5			0.5
10.	30	0	700	2	8			0.8
11.	30	0	7000	4	6			0.6
12.	30	140	2000	2	8			0.8
13.	33(3)	165(5)	7000	5	5			0.5
14.	33	0	700	1	8	1		1.0
15.	33	165	2000	3	7			0.7
16.	33	165	7000	4	6			0.6
17.	33	165	700		8	2		1.2
18.	33	0	700		6	3	1	1.5
19.	33	0	7000	6	4			0.4
20.	33	0	7000	2	8			0.8
21.	33	0	2000	2	8			0.8
22.	33	165	700		9		1	1.2
23.	33	165	2000	1	9			0.9
24.	33	0	2000	2	7	1		0.9
25.	33	165	7000	1	8	1		1.0

(1) - (5) See Table 6 for explanation.

TABLE 6C. SERIES 5 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Truck-Tractor	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: See Below
Date: December 2, 1966	Fuel: Reference No. 2

Run	Speed	Load	Dilution	"O" Standard Responses			
No.	MPH	HP	Ratio(1)	0	1	2	Average
1.	30(2)	0(4)	7000	3	7		0.7
2.	30	140	7000	5	5		0.5
3.	30	140	700	1	9		0.9
4.	30	0	2000	4	6		0.6
5.	30	0	2000	3	7		0.7
6.	30	140	700	4	6		0.6
7.	30	140	2000	4	6		0.6
8.	30	0	700	1	9		0.9
9.	30	140	7000	5	5		0.5
10.	30	0	700	2	8		0.8
11.	30	0	7000	2	8		0.8
12.	30	140	2000	2	8		0.8
13.	33(3)	165(5)	7000	2	8		0.8
14.	33	0	700	1	9		0.9
15.	33	165	2000	3	7		0.7
16.	33	165	7000	3	7		0.7
17.	33	165	700	2	8		0.8
18.	33	0	700	2	7	1	0.9
19.	33	0	7000	3	7		0.7
20.	33	0	7000	4	6		0.6
21.	33	0	2000	3	7		0.7
22.	33	165	700		10		1.0
23.	33	165	2000	4	6		0.6
24.	33	0	2000	3	7		0.7
25.	33	165	7000	1	9		0.9

(1) - (5) See Table 6 for explanation.

TABLE 6D. SERIES 5 PROCEDURAL DEVELOPMENT RESULTS

(Aromatic "A" Standard)

Vehicle: Truck-Tractor	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: See Below
Date: December 2, 1966	Fuel: Reference No. 2

Run	Speed	Load	Dilution	"A" Standard Responses			
No.	MPH	HP	Ratio(1)	0	1	2	Ave.
1.	30(2)	0	7000	10			0
2.	30	140(4)	7000	6	4		0.4
3.	30	140	700	6	4		0.4
4.	30	0	2000	6	4		0.4
5.	30	0	2000	9	1		0.1
6.	30	140	700	6	4		0.4
7.	30	140	2000	7	3		0.3
8.	30	0	700	8	2		0.2
9.	30	140	7000	7	3		0.3
10.	30	0	700	7	3		0.3
11.	30	0	7000	6	4		0.4
12.	30	140	2000	4	6		0.6
13.	33(3)	165(5)	7000	8	2		0.2
14.	33	0	700	3	7		0.7
15.	33	165	2000	9	1		0.1
16.	33	165	7000	6	4		0.4
17.	33	165	700	1	8	1	1.0
18.	33	0	700	1	9		0.9
19.	33	0	7000	8	2		0.2
20.	33	0	7000	8	2		0.2
21.	33	0	2000	8	2		0.2
22.	33	165	700	1	9		0.9
23.	33	165	2000	7	3		0.3
24.	33	0	2000	4	6		0.6
25.	33	165	7000	7	3		0.3

(1) - (5) See Table 6 for explanation.

TABLE 6E. SERIES 5 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 2, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"P" Standard Responses 0	1	Average
1.	30(2)	0	7000	10		0
2.	30	140(4)	7000	10		0
3.	30	140	700	5	5	0.5
4.	30	0	2000	9	1	0.1
5.	30	0	2000	7	3	0.3
6.	30	140	700	7	3	0.3
7.	30	140	2000	4	6	0.6
8.	30	0	700	9	1	0.1
9.	30	140	7000	10		0
10.	30	0	700	10		0
11.	30	0	7000	9	1	0.1
12.	30	140	2000	7	3	0.3
13.	33(3)	165(5)	7000	6	4	0.4
14.	33	0	700	10		0
15.	33	165	2000	5	5	0.5
16.	33	165	7000	9	1	0.1
17.	33	165	700	3	7	0.7
18.	33	0	700	2	8	0.8
19.	33	0	7000	10		0
20.	33	0	7000	10		0
21.	33	0	2000	10		0
22.	33	165	700	5	5	0.5
23.	33	165	2000	8	2	0.2
24.	33	0	2000	5	5	0.5
25.	33	165	7000	8	2	0.2

(1) - (5) See Table 6 for explanation.

TABLE 7. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Truck-Tractor - Constant Speed-Deceleration)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
3. a. (4)	700	54(2)	0	4	2	2.0	1	1	1.0	2	0	1.0	2	0	0.8	2	0	0.4
5. a.	700	54	0	4	2	3.6	2	0	1.0	1	0	0.8	2	0	0.9	0	0	0
						2.8			1.0			0.9			0.9			0.2
3. b. (5)	700	54	0	5	3	3.7	1	1	1.0	1	0	0.8	1	0	0.6	2	0	0.5
5. b.	700	54	0	4	2	3.4	1	1	1.0	1	0	0.8	2	0	0.9	0	0	0
						3.6			1.0			0.8			0.8			0.3
3. c. (6)	700	54	0	5	2	3.0	1	0	0.8	2	0	0.9	2	0	0.7	2	0	0.4
5. c.	700	54	0	4	2	3.3	1	0	0.8	2	0	0.8	2	0	0.8	0	0	0
						3.2			0.8			0.9			0.8			0.2
7. a.	700	54	130(7)	5	3	4.4	1	1	1.0	1	0	0.7	2	0	0.9	2	0	0.6
8. a.	700	54	130	5	4	4.9	1	0	0.9	1	0	0.7	1	0	0.6	1	0	0.4
						4.7			1.0			0.7			0.8			0.5
7. b.	700	54	130	5	3	4.4	1	1	1.0	1	0	0.8	2	0	0.9	1	0	0.4
8. b.	700	54	130	3	2	2.8	1	0	0.9	1	0	0.7	1	0	0.7	1	0	0.3
						3.6			1.0			0.8			0.8			0.4
7. c.	700	54	130	5	2	3.5	1	0	0.9	1	0	0.8	2	0	0.9	1	0	0.5
8. c.	700	54	130	3	2	2.4	1	0	0.8	1	0	0.6	1	0	0.4	1	0	0.1
						3.0			0.9			0.7			0.7			0.3
6. a.	2000	54	0	3	1	2.1	1	0	0.5	1	0	0.6	1	0	0.4	0	0	0
9. a.	2000	54	0	3	1	1.8	1	0	0.6	1	0	0.5	1	0	0.3	1	0	0.1
						2.0			0.6			0.6			0.4			0
6. b.	2000	54	0	3	1	1.9	1	0	0.6	1	0	0.5	1	0	0.4	1	0	0.1
9. b.	2000	54	0	3	1	1.6	1	0	0.6	1	0	0.5	1	0	0.2	0	0	0
						1.8			0.6			0.5			0.3			0
6. c.	2000	54	0	3	1	1.7	1	0	0.6	1	0	0.4	1	0	0.5	1	0	0.1
9. c.	2000	54	0	2	1	1.4	1	0	0.4	1	0	0.5	1	0	0.3	0	0	0
						1.6			0.5			0.4			0.4			0

TABLE 7. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
2. a.	2000	54	130	4	2	3.1	1	0	0.9	2	0	0.9	1	0	0.7	1	0	0.1
10. a.	2000	54	130	4	1	2.6	1	0	0.8	1	0	0.4	1	0	0.7	1	0	0.1
						2.9			0.9			0.7			0.7			0.1
2. b.	2000	54	130	4	2	2.8	1	0	0.9	2	0	0.9	1	0	0.7	1	0	0.1
10. b.	2000	54	130	4	1	2.3	1	0	0.4	1	0	0.4	1	0	0.8	1	0	0.2
						2.6			0.7			0.7			0.8			0.2
2. c.	2000	54	130	3	1	2.3	1	0	0.6	2	0	0.7	1	0	0.8	1	0	0.2
10. c.	2000	54	130	4	1	2.0	1	0	0.4	1	0	0.4	1	0	0.7	1	0	0.1
						2.2			0.5			0.6			0.8			0.2
11. a.	7000	54	0	3	1	1.8	1	0	0.6	1	0	0.3	2	0	1.0	1	0	0.3
12. a.	7000	54	0	3	1	1.6	1	0	0.4	1	0	0.6	1	0	0.5	1	0	0.2
						1.2			0.5			0.5			0.8			0.3
11. b.	7000	54	0	3	1	1.6	1	0	0.4	1	0	0.5	1	1	1.0	1	0	0.3
12. b.	7000	54	0	2	1	1.4	1	0	0.2	1	0	0.6	1	0	0.5	1	0	0.1
						1.5			0.3			0.6			0.7			0.2
11. c.	7000	54	0	3	1	1.6	1	0	0.4	1	0	0.4	1	0	0.7	1	0	0.4
12. c.	7000	54	0	2	1	1.1	1	0	0.1	1	0	0.5	1	0	0.5	0	0	0
						1.4			0.3			0.5			0.6			0.2
1. a.	7000	54	130	2	1	1.6	1	0	0.7	1	0	0.7	1	0	0.4	0	0	0
4. a.	7000	54	130	3	1	2.2	1	0	0.6	1	0	0.5	1	0	0.3	1	0	0.1
						1.9			0.7			0.6			0.4			0
1. b.	7000	54	130	2	1	1.5	1	0	0.5	1	0	0.7	1	0	0.4	0	0	0
4. b.	7000	54	130	3	1	2.2	1	0	0.7	1	0	0.5	1	0	0.3	1	0	0.2
						1.9			0.6			0.6			0.4			0.1
1. c.	7000	54	130	2	1	1.5	1	0	0.5	1	0	0.7	1	0	0.5	0	0	0
4. c.	7000	54	130	2	1	1.4	1	0	0.5	1	0	0.6	1	0	0.3	1	0	0.1
						1.5			0.5			0.7			0.4			0

TABLE 7. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 3

(Truck-Tractor - Constant - Deceleration)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
16. a.	700	35(3)	0	5	1	3.3	1	0	0.8	1	0	0.7	1	0	0.8	1	0	0.4
19. a.	700	35	0	5	4	4.2	1	1	1.0	1	0	0.9	1	0	0.7	1	0	0.6
						3.8			0.9			0.8			0.8			0.5
16. b.	700	35	0	5	1	3.2	1	0	0.7	1	0	0.6	1	0	0.6	1	0	0.6
19. b.	700	35	0	4	3	3.6	1	1	1.0	1	0	0.8	1	0	0.7	1	0	0.7
						3.4			0.9			0.7			0.7			0.7
16. c.	700	35	0	5	1	3.0	1	0	0.7	1	0	0.6	1	0	0.6	1	0	0.5
19. c.	700	35	0	4	2	3.0	1	0	0.8	1	0	0.7	1	0	0.6	1	0	0.6
						3.0			0.8			0.7			0.6			0.6
13. a.	700	35	140(8)	5	3	4.2	1	1	1.0	2	0	0.9	2	1	1.2	1	0	0.4
15. a.	700	35	140	5	4	4.3	1	1	1.0	1	0	0.8	1	0	0.8	1	0	0.6
						4.3			1.0			0.9			1.0			0.5
13. b.	700	35	140	5	2	3.6	1	0	0.8	2	0	0.8	2	0	1.2	1	0	0.4
15. b.	700	35	140	5	4	4.1	1	1	1.0	1	0	0.9	1	0	0.8	1	0	0.4
						3.9			0.9			0.9			1.0			0.4
13. c.	700	35	140	5	1	3.4	1	0	0.7	1	0	0.7	2	0	0.9	1	0	0.1
15. c.	700	35	140	4	2	3.3	1	0	0.8	1	0	0.6	1	0	0.8	1	0	0.3
						3.4			0.8			0.7			0.9			0.2
23. a.	2000	35	0	4	1	2.6	1	0	0.8	2	0	0.8	1	0	0.2	1	0	0.6
24. a.	2000	35	0	3	1	1.4	1	0	0.5	1	0	0.8	1	0	0.1	1	0	0.4
						2.0			0.7			0.8			0.2			0.5
23. b.	2000	35	0	3	1	2.2	1	0	0.6	1	0	0.7	1	0	0.2	1	0	0.4
24. b.	2000	35	0	2	1	1.5	1	0	0.5	1	0	0.6	1	0	0.1	1	0	0.3
						1.9			0.6			0.7			0.2			0.4
23. c.	2000	35	0	3	1	1.9	1	0	0.5	1	0	0.7	1	0	0.2	1	0	0.5
24. c.	2000	35	0	2	1	1.3	1	0	0.5	1	0	0.7	1	0	0.1	1	0	0.4
						1.6			0.5			0.7			0.2			0.5

TABLE 7. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 4

(Truck-Tractor - Constant-Deceleration)

Run No.	Dilution Ratio	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
21. a.	2000	35	150	4	2	3. 3	1	1	1. 0	1	0	0. 6	1	0	0. 3	1	0	0. 9
22. a.	2000	35	150	3	2	2. 9	1	0	0. 9	1	0	0. 7	1	0	0. 3	1	0	0. 9
						3. 1			1. 0			0. 7			0. 3			0. 9
21. b.	2000	35	150	4	2	3. 2	1	1	1. 0	1	0	0. 6	1	0	0. 3	1	0	0. 8
22. b.	2000	35	150	3	2	2. 6	1	0	0. 8	1	0	0. 7	1	0	0. 4	1	0	0. 8
						2. 9			0. 9			0. 7			0. 4			0. 8
21. c.	2000	35	150	6	1	3. 1	1	0	0. 8	1	0	0. 6	1	0	0. 3	1	0	0. 8
22. c.	2000	35	150	3	1	2. 2	1	0	0. 7	1	0	0. 5	1	0	0. 2	1	0	0. 5
						2. 7			0. 8			0. 6			0. 3			0. 7
17. a.	7000	35	140	3	1	2. 3	1	0	0. 8	1	0	0. 7	1	0	0. 5	1	0	0. 3
20. a.	7000	35	140	3	1	1. 7	1	0	0. 5	1	0	0. 8	1	0	0. 2	1	0	0. 1
						2. 0			0. 7			0. 8			0. 4			0. 2
17. b.	7000	35	140	3	1	2. 1	1	0	0. 6	1	0	0. 6	1	0	0. 4	1	0	0. 5
20. b.	7000	35	140	2	1	1. 4	1	0	0. 5	1	0	0. 8	1	0	0. 2	1	0	0. 1
						1. 8			0. 6			0. 7			0. 3			0. 3
17. c.	7000	35	140	3	1	1. 9	1	0	0. 7	1	0	0. 6	1	0	0. 4	1	0	0. 3
20. c.	7000	35	140	2	1	1. 4	1	0	0. 6	1	0	0. 8	1	0	0. 2	1	0	0. 1
						1. 7			0. 7			0. 7			0. 3			0. 2

(1) Constant Sampling
(2) Operated at 54 mph in 9th gear at 2200 rpm engine speed for 60 seconds followed by closed rack deceleration
(3) Operated at 35 mph in 9th gear at 1500 rpm engine speed for 60 seconds followed by closed rack deceleration
(4) Exposure "a" 5 seconds after closed rack deceleration
(5) Exposure "b" 25 seconds after closed rack deceleration
(6) Exposure "c" 45 seconds after closed rack deceleration
(7) Open rack, maximum power
(8) Open rack, maximum power

TABLE 7A. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS

(Diesel "D" Composite Standard)

Vehicle: Truck-Tractor	Type Operation: Constant Deceleration
Sample Method: Constant	Vehicle Speed: See notes (2) and (3)
Date: December 5, 1966	Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Responses 1	2	3	4	5	Ave.
1. a. (4)	54(2)	130(7)	7000	4	6				1.6
b. (5)	54	130	7000	5	5				1.5
c. (6)	54	130	7000	5	5				1.5
2. a.	54	130	2000		2	5	3		3.1
b.	54	130	2000		2	4	4		2.8
c.	54	130	2000	1	5	4			2.3
3. a.	54	0	700		4	2	4		2.0
b.	54	0	700			6	1	3	3.7
c.	54	0	700		4	2	1	3	3.0
4. a.	54	130	7000	2	4	4			2.2
b.	54	130	7000	2	4	4			2.2
c.	54	130	7000	6	4				1.4
5. a.	54	0	700		1	2	7		3.6
b.	54	0	700		2	2	6		3.4
c.	54	0	700		2	3	5		3.3
6. a.	54	0	2000	1	7	2			2.1
b.	54	0	2000	2	7	1			1.9
c.	54	0	2000	4	5	1			1.7
7. a.	54	130	700			1	4	5	4.4
b.	54	130	700			2	5	3	4.1
c.	54	130	700		1	4	4	1	3.5
8. a.	54	130	700				1	9	4.9
b.	54	130	700		2	8			2.8
c.	54	130	700		6	4			2.4
9. a.	54	0	2000	3	6	1			1.8
b.	54	0	2000	5	4	1			1.6
c.	54	0	2000	6	4				1.4
10. a.	54	130	2000	1	4	3	2		2.6
b.	54	130	2000	3	3	2	2		2.3
c.	54	130	2000	3	5	1	1		2.0
11. a.	54	0	7000	4	4	2			1.8
b.	54	0	7000	5	4	1			1.6
c.	54	0	7000	5	4	1			1.6
12. a.	54	0	7000	6	2	2			1.6
b.	54	0	7000	6	4				1.4
c.	54	0	7000	9	1				1.1

TABLE 7A. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS Page 2

(Diesel "D" Composite Standard)

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Responses 1	2	3	4	5	Ave.
13. a.	35(3)	120(8)	700			2	4	4	4. 2
b.	35	120	700		2		4	4	3. 6
c.	35	120	700	1	1	3	3	2	3. 4
14. a.	35	0	7000	3	7				1. 7
b.	35	0	7000	4	6				1. 6
c.	35	0	7000	7	3				1. 3
15. a.	35	130	700				7	3	4. 3
b.	35	130	700				9	1	4. 1
c.	35	130	700		1	5	4		3. 3
16. a.	35	0	700	2		3	3	2	3. 3
b.	35	0	700	2		4	2	2	3. 2
c.	35	0	700	2	1	4	1	2	3. 0
17. a.	35	140	7000	2	3	5			2. 3
b.	35	140	7000	2	5	3			2. 1
c.	35	140	7000	5	1	4			1. 9
18. a.	35	0	7000	1	5	2	2		2. 5
b.	35	0	7000	2	4	2	2		2. 4
c.	35	0	7000	1	3	6			2. 5
19. a.	35	0	700				8	2	4. 2
b.	35	0	700			4	6		3. 6
c.	35	0	700		3	4	3		3. 0
20. a.	35	140	7000	4	5	1			1. 7
b.	35	140	7000	6	4				1. 4
c.	35	140	7000	6	4				1. 4
21. a.	35	150	2000		3	1	6		3. 3
b.	35	150	2000		4		6		3. 2
c.	35	150	2000	1	3		6		3. 1
22. a.	35	150	2000		1	9			2. 9
b.	35	150	2000		4	6			2. 6
c.	35	150	2000	1	6	3			2. 2
23. a.	35	0	2000	1	3	5	1		2. 6
b.	35	0	2000	3	2	5			2. 2
c.	35	0	2000	4	3	3			1. 9
24. a.	35	0	2000	4	5	1			1. 4
b.	35	0	2000	5	5				1. 5
c.	35	0	2000	7	3				1. 3

(1) - (8) See Table 7 for explanation.

TABLE 7B. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 5, 1966

Type Operation: Constant Deceleration
Vehicle Speed: See notes (2) and (3)
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	Burnt-Smoky "B" Responses			
				0	1	2	Average
1. a. (4)	54(2)	130(7)	7000	3	7		0.7
b. (5)	54	130	7000	5	5		0.5
c. (6)	54	130	7000	5	5		0.5
2. a.	54	130	2000	1	9		0.9
b.	54	130	2000	1	9		0.9
c.	54	130	2000	4	6		0.6
3. a.	54	0	700		10		1.0
b.	54	0	700		10		1.0
c.	54	0	700	2	8		0.8
4. a.	54	130	7000	4	6		0.6
b.	54	130	7000	3	7		0.7
c.	54	130	7000	5	5		0.5
5. a.	54	0	700	1	8	1	1.0
b.	54	0	700		10		1.0
c.	54	0	700	2	8		0.8
6. a.	54	0	2000	5	5		0.5
b.	54	0	2000	4	6		0.6
c.	54	0	2000	4	6		0.6
7. a.	54	130	700		10		1.0
b.	54	130	700		10		1.0
c.	54	130	700	1	9		0.9
8. a.	54	130	700	1	9		0.9
b.	54	130	700	1	9		0.9
c.	54	130	700	2	8		0.8
9. a.	54	0	2000	4	6		0.6
b.	54	0	2000	4	6		0.6
c.	54	0	2000	6	4		0.4
10. a.	54	130	2000	2	8		0.8
b.	54	130	2000	6	4		0.4
c.	54	130	2000	6	4		0.4
11. a.	54	0	7000	4	6		0.6
b.	54	0	7000	6	4		0.4
c.	54	0	7000	6	4		0.4
12. a.	54	0	7000	6	4		0.4
b.	54	0	7000	8	2		0.2
c.	54	0	7000	9	1		0.1

TABLE 7B. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Burnt-Smoky "B" Standard)

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"B" Standard Responses 0	1	2	Average
13. a.	35(3)	120(8)	700		10		1.0
b.	35	120	700	2	8		0.8
c.	35	120	700	3	7		0.7
14. a.	35	0	7000	3	7		0.7
b.	35	0	7000	3	7		0.7
c.	35	0	7000	5	5		0.5
15. a.	35	130	700		10		1.0
b.	35	130	700		10		1.0
c.	35	130	700	2	8		0.8
16. a.	35	0	700	2	8		0.8
b.	35	0	700	3	7		0.7
c.	35	0	700	3	7		0.7
17. a.	35	140	7000	2	8		0.8
b.	35	140	7000	4	6		0.6
c.	35	140	7000	3	7		0.7
18. a.	35	0	7000	2	8		0.8
b.	35	0	7000		10		1.0
c.	35	0	7000	1	9		0.9
19. a.	35	0	700		10		1.0
b.	35	0	700		10		1.0
c.	35	0	700	2	8		0.8
20. a.	35	140	7000	2	8		0.5
b.	35	140	7000	5	5		0.5
c.	35	140	7000	4	6		0.6
21. a.	35	150	2000		10		1.0
b.	35	150	2000		10		1.0
c.	35	150	2000	2	8		0.8
22. a.	35	150	2000	1	9		0.9
b.	35	150	2000	2	8		0.8
c.	35	150	2000	3	7		0.7
23. a.	35	0	2000	2	8		0.8
b.	35	0	2000	4	6		0.6
c.	35	0	2000	5	5		0.5
24. a.	35	0	2000	5	5		0.5
b.	35	0	2000	5	5		0.5
c.	35	0	2000	5	5		0.5

(1) - (8) See Table 7 for explanation.

TABLE 7C. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard,

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 5, 1966

Type Operation: Constant Deceleration
Vehicle Speed: See notes (2) and (3)
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"O" Standard Responses 0	1	2	Average
1. a. (4)	54(2)	130(7)	7000	3	7		0.7
b. (5)	54	130	7000	3	7		0.7
c. (6)	54	130	7000	3	7		0.7
2. a.	54	130	2000	2	7	1	0.9
b.	54	130	2000	2	7	1	0.9
c.	54	130	2000	4	5	1	0.7
3. a.	54	0	700	1	8	1	1.0
b.	54	0	700	2	8		0.8
c.	54	0	700	2	7	1	0.9
4. a.	54	130	7000	5	5		0.5
b.	54	130	7000	5	5		0.5
c.	54	130	7000	4	6		0.6
5. a.	54	0	700	2	8		0.8
b.	54	0	700	2	8		0.8
c.	54	0	700	3	6	1	0.8
6. a.	54	0	2000	4	6		0.6
b.	54	0	2000	5	5		0.5
c.	54	0	2000	6	4		0.4
7. a.	54	130	700	3	7		0.7
b.	54	130	700	2	8		0.8
c.	54	130	700	2	8		0.8
8. a.	54	130	700	3	7		0.7
b.	54	130	700	3	7		0.7
c.	54	130	700	4	6		0.6
9. a.	54	0	2000	5	5		0.5
b.	54	0	2000	5	5		0.5
c.	54	0	2000	5	5		0.5
10. a.	54	130	2000	6	4		0.4
b.	54	130	2000	6	4		0.4
c.	54	130	2000	6	4		0.4
11. a.	54	0	7000	7	3		0.3
b.	54	0	7000	5	5		0.5
12. a.	54	0	7000	6	4		0.4
13. a.	54	0	7000	4	6		0.6
b.	54	0	7000	4	6		0.6
c.	54	0	7000	5	5		0.5

TABLE 7C. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS Page 2

(Oily "O" Standard)

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"O" Standard Responses			
				0	1	2	Ave.
13. a.	35(3)	120(8)	700	2	7	1	0.9
b.	35	120	700	3	6	1	0.8
c.	35	120	700	3	7		0.7
14. a.	35	0	7000	7	3		0.3
b.	35	0	7000	6	4		0.4
c.	35	0	7000	6	4		0.4
15. a.	35	130	700	2	8		0.8
b.	35	130	700	1	9		0.9
c.	35	130	700	4	6		0.6
16. a.	35	0	700	3	7		0.7
b.	35	0	700	4	6		0.6
c.	35	0	700	4	6		0.6
17. a.	35	140	7000	3	7		0.7
b.	35	140	7000	4	6		0.6
c.	35	140	7000	4	6		0.6
18. a.	35	0	7000	4	5	1	0.7
b.	35	0	7000	4	5	1	0.7
c.	35	0	7000	5	4	1	0.6
19. a.	35	0	700	1	9		0.9
b.	35	0	700	2	8		0.8
c.	35	0	700	3	7		0.7
20. a.	35	140	7000	2	8		0.8
b.	35	140	7000	2	8		0.8
c.	35	140	7000	2	8		0.8
21. a.	35	150	2000	4	6		0.6
b.	35	150	2000	4	6		0.6
c.	35	150	2000	4	6		0.6
22. a.	35	150	2000	3	7		0.7
b.	35	150	2000	3	7		0.7
c.	35	150	2000	5	5		0.5
23. a.	35	0	2000	3	6	1	0.8
b.	35	0	2000	3	7		0.7
c.	35	0	2000	3	7		0.7
24. a.	35	0	2000	2	8		0.8
b.	35	0	2000	4	6		0.6
c.	35	0	2000	3	7		0.7

(1) - (8) Table 7 for explanation.

TABLE 7D. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS

(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 5, 1966

Type Operation: Constant Deceleration
Vehicle Speed: See notes (2) and (3)
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"A" Standard Responses 0	1	2	Ave.
1. a. (4)	54(2)	130(7)	7000	6	4		0.4
b. (5)	54	130	7000	6	4		0.4
c. (6)	54	130	7000	5	5		0.5
2. a.	54	130	2000	3	7		0.7
b.	54	130	2000	3	7		0.7
c.	54	130	2000	2	8		0.8
3. a.	54	0	700	3	6	1	0.8
b.	54	0	700	4	6		0.6
c.	54	0	700	4	5	1	0.7
4. a.	54	130	7000	7	3		0.3
b.	54	130	7000	7	3		0.3
c.	54	130	7000	7	3		0.3
5. a.	54	0	700	2	7	1	0.9
b.	54	0	700	2	7	1	0.9
c.	54	0	700	3	6	1	0.8
6. a.	54	0	2000	6	4		0.4
b.	54	0	2000	6	4		0.4
c.	54	0	2000	5	5		0.5
7. a.	54	130	700	2	7	1	0.9
b.	54	130	700	2	7	1	0.9
c.	54	130	700	2	7	1	0.9
8. a.	54	130	700	4	6		0.6
b.	54	130	700	3	7		0.7
c.	54	130	700	6	4		0.4
9. a.	54	0	2000	7	3		0.3
b.	54	0	2000	8	2		0.2
c.	54	0	2000	7	3		0.3
10. a.	54	130	2000	3	7		0.7
b.	54	130	2000	2	8		0.8
c.	54	130	2000	3	7		0.7
11. a.	54	0	7000	1	8	1	1.0
b.	54	0	7000		10		1.0
c.	54	0	7000	3	7		0.7
12. a.	54	0	7000	5	5		0.5
b.	54	0	7000	5	5		0.5
c.	54	0	7000	5	5		0.5

TABLE 7D. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS Page 2
(Aromatic "A" Standard)

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"A" Standard Responses 0	1	2	Average
13. a.	35(3)	120(8)	700		8	2	1. 2
b.	35	120	700	1	6	3	1. 2
c.	35	120	700	2	7	1	0. 9
14. a.	35	0	7000	8	2		0. 2
b.	35	0	7000	7	3		0. 3
c.	35	0	7000	8	2		0. 2
15. a.	35	130	700	2	8		0. 8
b.	35	130	700	2	8		0. 8
c.	35	130	700	2	8		0. 8
16. a.	35	0	700	2	8		0. 8
b.	35	0	700	4	6		0. 6
c.	35	0	700	4	6		0. 6
17. a.	35	140	7000	5	5		0. 5
b.	35	140	7000	6	4		0. 4
c.	35	140	7000	6	4		0. 4
18. a.	35	0	7000	7	3		0. 3
b.	35	0	7000	7	3		0. 3
c.	35	0	7000	7	3		0. 3
19. a.	35	0	700	3	7		0. 7
b.	35	0	700	3	7		0. 7
c.	35	0	700	4	6		0. 6
20. a.	35	140	7000	8	2		0. 2
b.	35	140	7000	8	2		0. 2
c.	35	140	7000	8	2		0. 2
21. a.	35	150	2000	7	3		0. 3
b.	35	150	2000	7	3		0. 3
c.	35	150	2000	7	3		0. 3
22. a.	35	150	2000	7	3		0. 3
b.	35	150	2000	6	4		0. 4
c.	35	150	2000	8	2		0. 2
23. a.	35	0	2000	8	2		0. 2
b.	35	0	2000	8	2		0. 2
c.	35	0	2000	8	2		0. 2
24. a.	35	0	2000	9	1		0. 1
b.	35	0	2000	9	1		0. 1
c.	35	0	2000	9	1		0. 1

(1) - (8) See Table 7 for explanation.

TABLE 7E. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor	Type Operation: Constant Deceleration
Sample Method: Constant	Vehicle Speed: See notes (2) and (3)
Date: December 5, 1966	Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"P" Standard Responses 0	1	2	Ave.
1. a. (4)	54(2)	130(7)	7000	10			0
b. (5)	54	130	7000	10			0
c. (6)	54	130	7000	10			0
2. a.	54	130	2000	9	1		0.1
b.	54	130	2000	9	1		0.1
c.	54	130	2000	8	2		0.2
3. a.	54	0	700	7	2	1	0.4
b.	54	0	700	7	1	2	0.5
c.	54	0	700	7	2	1	0.4
4. a.	54	130	7000	9	1		0.1
b.	54	130	7000	8	2		0.2
c.	54	130	7000	9	1		0.1
5. a.	54	0	700	10			0
b.	54	0	700	10			0
c.	54	0	700	10			0
6. a.	54	0	2000	10			0
b.	54	0	2000	9	1		0.1
c.	54	0	2000	9	1		0.1
7. a.	54	130	700	5	4	1	0.6
b.	54	130	700	6	4		0.4
c.	54	130	700	5	5		0.5
8. a.	54	130	700	6	4		0.4
b.	54	130	700	7	3		0.3
c.	54	130	700	9	1		0.1
9. a.	54	0	2000	9	1		0.1
b.	54	0	2000	10			0
c.	54	0	2000	10			0
10. a.	54	130	2000	9	1		0.1
b.	54	130	2000	8	2		0.2
c.	54	130	2000	9	1		0.1
11. a.	54	0	7000	7	3		0.3
b.	54	0	7000	7	3		0.3
c.	54	0	7000	6	4		0.4
12. a.	54	0	7000	8	2		0.2
b.	54	0	7000	9	1		0.1
c.	54	0	7000	10			0

TABLE 7E. SERIES 6 PROCEDURAL DEVELOPMENT RESULTS Page 2

(Pungent "P" Standard)

Run	Speed	Load	Dilution	"P" Standard Responses			
No.	MPH	HP	Ratio(1)	0	1	2	Ave.
13. a.	35(3)	120(8)	700	6	4		0.4
b.	35	120	700	6	4		0.4
c.	35	120	700	9	1		0.1
14. a.	35	0	7000	10			0
b.	35	0	7000	10			0
c.	35	0	7000	10			0
15. a.	35	130	700	4	6		0.6
b.	35	130	700	6	4		0.4
c.	35	130	700	7	3		0.3
16. a.	35	0	700	6	4		0.4
b.	35	0	700	4	6		0.6
c.	35	0	700	5	5		0.5
17. a.	35	140	7000	7	3		0.3
b.	35	140	7000	5	5		0.5
c.	35	140	7000	7	3		0.3
18. a.	35	0	7000	7	3		0.3
b.	35	0	7000	9	1		0.1
c.	35	0	7000	10			0
19. a.	35	0	700	4	6		0.6
b.	35	0	700	3	7		0.7
c.	35	0	700	4	6		0.6
20. a.	35	140	7000	9	1		0.1
b.	35	140	7000	9	1		0.1
c.	35	140	7000	9	1		0.1
21. a.	35	150	2000	1	9		0.9
b.	35	150	2000	2	8		0.8
c.	35	150	2000	2	8		0.8
22. a.	35	150	2000	1	9		0.9
b.	35	150	2000	2	8		0.8
c.	35	150	2000	5	5		0.5
23. a.	35	0	2000	4	6		0.6
b.	35	0	2000	6	4		0.4
c.	35	0	2000	5	5		0.5
24. a.	35	0	2000	6	4		0.4
b.	35	0	2000	7	3		0.3
c.	35	0	2000	6	4		0.4

(1) - (8) See Table 7 for explanation.

TABLE 8. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(Truck-Tractor - Constant Speed)

Run	Dilution	Speed	Load	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
No.	Ratio(1)	MPH	HP	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
2.	700	25(2)	0	3	1	1.7	1	0	0.9	1	0	0.7	1	0	0.2	1	0	0.2
6.	700	25	0	[illegible]	2	3.5	1	0	0.8	1	0	0.8	2	0	0.7	1	0	0.1
						2.6			0.9			0.8			0.5			0.2
5.	700	25	140(4)	5	3	4.3	1	1	1.0	1	1	1.0	2	0	1.1	1	0	0.1
10	700	25	140	5	4	4.9	2	1	1.5	1	1	1.0	2	0	0.8	1	0	0.8
						4.6			1.5			1.0			1.0			0.5
9.	2000	25	0	3	1	1.6	1	0	0.4	1	0	0.7	1	0	0.1	0	0	0
12.	2000	25	0	2	1	1.4	1	0	0.7	1	0	0.5	1	0	0.1	0	0	0
						1.5			0.6			0.6			0.1			0
3.	2000	25	140	4	1	2.1	1	0	0.7	1	0	0.6	1	0	0.2	0	0	0
11.	2000	25	140	3	2	2.5	2	0	1.0	2	0	0.9	0	0	0	1	0	0.2
						2.3			0.9			0.8			0.1			0.1
7.	7000	25	0	2	1	0.1	1	0	0.3	1	0	0.4	0	0	0	1	0	0.1
8.	7000	25	0	3	1	1.8	1	0	0.8	1	0	0.4	0	0	0	1	0	0.1
						1.0			0.6			0.4			0			0.1
1.	7000	25	140	2	1	0.8	1	0	0.6	1	0	0.7	0	0	0	0	0	0
4.	7000	25	140	1	1	1.0	1	0	0.5	1	0	0.5	1	0	0.1	0	0	0
						0.9			0.6			0.6			0			0
20.	700	21(3)	0	4	2	3.6	2	1	1.1	1	0	0.9	1	0	0.6	1	0	0.5
22.	700	21	0	4	4	4.0	1	1	1.0	1	0	0.8	1	0	0.6	1	0	0.5
						3.8			1.0			0.9			0.6			0.5
15.	700	21	130(5)	5	2	3.1	1	0	0.7	2	0	0.9	1	0	0.4	1	0	0.4
18.	700	21	130	4	1	3.0	1	0	0.8	2	0	0.8	2	0	0.8	1	0	0.4
						3.0			0.8			0.9			0.6			0.4
16.	2000	21	0	2	1	1.4	1	0	0.5	1	0	0.4	1	0	0.2	1	0	0.1
17.	2000	21	0	2	1	1.0	1	0	0.4	1	0	0.3	1	0	0.3	1	0	0.1
						1.2			0.5			0.4			0.3			0.1

TABLE 8. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Truck-Tractor - Constant Speed)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
19.	2000	21	130	3	2	2.5	1	0	0.9	1	0	0.8	1	0	0.5	1	0	0.2
24.	2000	21	130	3	3	3.0	1	1	1.0	1	0	0.8	2	0	0.6	1	0	0.2
						2.8			1.0			0.8			0.6			0.2
13.	7000	21	0	2	1	1.1	1	0	0.5	1	0	0.5	0	0	0	0	0	0
23.	7000	21	0	3	3	3.0	1	1	1.0	1	0	0.9	1	0	0.4	1	0	0.3
						2.0			0.8			0.7			0.2			0.2
14.	7000	21	130	3	1	1.7	1	0	0.5	1	0	0.5	0	0	0	1	0	0.2
21.	7000	21	130	2	1	1.3	1	0	0.5	1	0	0.6	0	0	0	1	0	0.1
						1.5			0.5			0.6			0			0.2

(1) Constant Sampling

(2) Runs 1-12 all in 6th gear at 25 mph, engine at 2200 rpm

(3) Runs 13-24 all in 7th gear at 21 mph, engine at 1400 rpm

(4) Open rack - maximum power

(5) Open rack - maximum power

TABLE 8A. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Diesel "D" Composite Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 6, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Diesel Responses 1	2	3	4	5	6	Ave.
1.	25(2)	140(4)	7000	6	4					0.8
2.	25	0	700	3	4	3				1.7
3.	25	140	2000	2	4	3	1			2.1
4.	25	140	7000	10						1.0
5.	25	140	700			1	5	4		4.3
6.	25	0	700		2	2	5	1		3.5
7.	25	0	7000	9	1					1.0
8.	25	0	7000	4	4	2				1.8
9.	25	0	2000	5	4	1				1.6
10.	25	140	700				1	9		4.9
11.	25	140	2000		5	5				2.5
12.	25	0	2000	6	4					1.4
13.	21(3)	0	7000	9	1					1.1
14.	21	130(5)	7000	4	5	1				1.7
15.	21	130	700		4	2	3	1		3.1
16.	21	0	2000	6	4					1.4
17.	21	0	2000	9	1					1.0
18.	21	130	700	2		4	4			3.0
19.	21	130	2000		5	5				2.5
20.	21	0	700		1	2	7			3.6
21.	21	130	7000	7	3					1.3
22.	21	0	700				10			4.0
23.	21	0	7000			10				3.0
24.	21	130	2000			10				3.0

(1) - (5) See Table 8 for explanation.

TABLE 8B. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 6, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"B" Standard Responses 0	1	2	Average
1.	25(2)	140(4)	7000	4	6		0.6
2.	25	0	700	1	9		0.9
3.	25	140	2000	3	7		0.7
4.	25	140	7000	5	5		0.5
5.	25	140	700		10		1.0
6.	25	0	700	2	8		0.8
7.	25	0	7000	7	3		0.3
8.	25	0	7000	2	8		0.8
9.	25	0	2000	6	4		0.4
10.	25	140	700		5	5	1.5
11.	25	140	2000	1	8	1	1.0
12.	25	0	2000	3	7		0.7
13.	21(3)	0	7000	5	5		0.5
14.	21	130(5)	7000	5	5		0.5
15.	21	130	700	3	7		0.7
16.	21	0	2000	5	5		0.5
17.	21	0	2000	6	4		0.4
18.	21	130	700	2	8		0.8
19.	21	130	2000	1	9		0.9
20.	21	0	700		9	1	1.1
21.	21	130	7000	5	5		0.5
22.	21	0	700		10		1.0
23.	21	0	7000		10		1.0
24.	21	130	2000		10		1.0

(1) - (2) See Table 8 for explanation.

TABLE 8C. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 6, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run	Speed	Load	Dilution	"O" Standard Responses			
No.	MPH	HP	Ratio(1)	0	1	2	Average
1.	25(2)	140(4)	7000	3	7		0.7
2.	25	0	700	3	7		0.7
3.	25	140	2000	4	6		0.6
4.	25	140	7000	5	5		0.5
5.	25	140	700		10		1.0
6.	25	0	700	2	8		0.8
7.	25	0	7000	6	4		0.4
8.	25	0	7000	6	4		0.4
9.	25	0	2000	3	7		0.7
10.	25	140	700		10		1.0
11.	25	140	2000	2	7	1	0.9
12.	25	0	2000	5	5		0.5
13.	21(3)	0	7000	5	5		0.5
14.	21	130(5)	7000	5	5		0.5
15.	21	130	700	2	7	1	0.9
16.	21	0	2000	6	4		0.4
17.	21	0	2000	7	3		0.3
18.	21	130	700	3	6	1	0.8
19.	21	130	2000	2	8		0.8
20.	21	0	700	1	9		0.9
21.	21	130	7000	4	6		0.6
22.	21	0	700	2	8		0.8
23.	21	0	7000	1	9		0.9
24.	21	130	2000	2	8		0.8

(1) - (5) See Table 8 for explanation.

TABLE 8D. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 6, 1966

Type Operation: Constant Speed
Vehicle Speed: See Below
Fuel: Reference No. 2

Run	Speed	Load	Dilution	"A" Standard Responses			
No.	MPH	HP	Ratio(1)	0	1	2	Average
1.	25(2)	140(4)	7000	10			0
2.	25	0	700	8	2		0.2
3.	25	140	2000	8	2		0.2
4.	25	140	7000	9	1		0.1
5.	25	140	700	2	5	3	1.1
6.	25	0	700	5	3	2	0.7
7.	25	0	7000	10			0
8.	25	0	7000	10			0
9.	25	0	2000	9	1		0.1
10.	25	140	700	3	6	1	0.8
11.	25	140	2000	10			0
12.	25	0	2000	9	1		0.1
13.	21(3)	0	7000	10			0
14.	21	130(5)	7000	10			0
15.	21	130	700	6	4		0.4
16.	21	0	2000	8	2		0.2
17.	21	0	2000	7	3		0.3
18.	21	130	700	3	6	1	0.8
19.	21	130	2000	5	5		0.5
20.	21	0	700	4	6		0.6
21.	21	130	7000	10			0
22.	21	0	700	4	6		0.6
23.	21	0	7000	6	4		0.4
24.	21	130	2000	5	4	1	0.6

(1) - (5) See Table 8 for explanation.

TABLE 8E. SERIES 7 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor	Type Operation: Constant Speed
Sample Method: Constant	Vehicle Speed: See Below
Date: December 6, 1966	Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"P" Standard Responses 0	1	Average
1.	25(2)	140(4)	7000	10		0
2.	25	0	700	8	2	0. 2
3.	25	140	2000	10		0
4.	25	140	7000	10		0
5.	25	140	700	9	1	0. 1
6.	25	0	700	9	1	0. 1
7.	25	0	7000	9	1	0. 1
8.	25	0	7000	9	1	0. 1
9.	25	0	2000	10		0
10.	25	140	700	2	8	0. 8
11.	25	140	2000	8	2	0. 2
12.	25	0	2000	10		0
13.	21(3)	0	7000	10		0
14.	21	130(5)	7000	8	2	0. 2
15.	21	130	700	6	4	0. 4
16.	21	0	2000	9	1	0. 1
17.	21	0	2000	9	1	0. 1
18.	21	130	700	6	4	0. 4
19.	21	130	2000	8	2	0. 2
20.	21	0	700	5	5	0. 5
21.	21	130	7000	9	1	0. 1
22.	21	0	700	5	5	0. 5
23.	21	0	7000	7	3	0. 3
24.	21	130	2000	8	2	0. 2

(1) - (5) See Table 8 for explanation.

TABLE 9. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(Truck-Tractor - Constant Speed-Idle)

Run No.	Dilution Ratio(1)	Speed MPH(2)	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burn Max.	"B" Burn Min.	"B" Burn Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
1.	700	37-0	0	4	3	3.5	1	0	0.9	1	0	0.9	1	0	0.7	1	0	0.5
6.	700	37	0	5	3	4.0	1	0	0.9	1	0	0.8	1	0	0.4	1	0	0.6
14.	700	37	0	3	2	2.8	1	0	1.0	1	0	0.8	1	0	0.6	1	0	0.4
						3.4			0.9			0.9			0.6			0.5
3.	700	37	150(3)	4	3	3.7	1	0.5	1.0	1	0	0.6	1	0	1.0	1	0	0.3
10.	700	37	150	5	4	4.4	2	1	1.1	2	1	1.1	1	0	0.8	1	0	0.5
13.	700	37	150	5	3	4.1	1	1	1.0	1	0	0.9	1	0	0.7	1	0	0.4
						4.1			1.0			0.9			0.6			0.4
4.	2000	37	0	3	1	2.1	1	0	0.4	1	0	0.7	1	0	0.7	1	0	0.1
11.	2000	37	0	2	1	1.6	1	0	0.3	1	0	0.7	1	0	0.2	1	0	0.1
						1.9			0.4			0.7			0.5			0.1
5.	2000	37	150	5	2	3.3	2	0	1.1	1	0	0.6	1	0	0.7	1	0	0.5
8.	2000	37	150	4	2	2.6	1	0	0.7	1	0	0.5	1	0	0.9	1	0	0.5
						3.0			0.9			0.6			0.8			0.5
7.	7000	37	0	3	1	2.0	1	0	0.8	1	0	0.7	1	0	0.6	1	0	0.1
9.	7000	37	0	4	3	3.5	1	0	0.9	1	1	1.0	1	0	0.3	1	0	0.1
						2.8			0.9			0.9			0.5			0.1
2.	7000	37	150	4	1	2.1	1	0	0.6	1	0	0.7	1	0	0.3	1	0	0.2
12.	7000	37	150	2	1	1.1	1	0	0.3	1	0	0.7	1	0	0.1	1	0	0.2
15.	7000	37	150	4	1	2.7	1	0	0.8	1	0	0.7	1	0	0.3	1	0	0.2
						2.0			0.6			0.7			0.3			0.2

(1) Constant Sampling

(2) Operated at 1900 rpm 8th gear for 1 minute followed by closed rack deceleration to 30 mph and engine allowed to idle. Exposure begun after 30 seconds of idle.

(3) Open rack, maximum power at 37 mph

TABLE 9A. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Diesel "D" Composite Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 7, 1966

Type Operation: Constant Speed-Idle
Vehicle Speed: See Footnote (2)
Fuel: Reference No. 2

Run No.	Speed MPH(2)	Load HP	Dilution Ratio(1)	"D" Composite Responses						
				1	2	2.5	3	4	5	Average
1.	37	0	700				5	5		3.5
2.	37	150(3)	7000	1	5	1	2	1		2.1
3.	37	150	700				3	7		3.7
4.	37	0	2000	2	5		3			2.1
5.	37	150	2000		1			4	5	3.3
6.	37	0	700				1	8	1	4.0
7.	37	0	7000	2	6		2			2.0
8.	37	150	2000		5		4	1		2.6
9.	37	0	7000				5	5		3.5
10.	37	150	700					6	4	4.4
11.	37	0	2000	4	6					1.6
12.	37	150	7000	9	1					1.1
13.	37	150	700				2	5	3	4.1
14.	37	0	700		2		8			2.8
15.	37	150	7000	3	2			5		2.7

(1) - (3) See Table 9 for explanation.

TABLE 9B. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor	Type Operation: Constant Speed-Idle
Sample Method: Constant	Vehicle Speed: See Footnote (2)
Date: December 7, 1966	Fuel: Reference No. 2

Run No.	Speed MPH(2)	Load HP	Dilution Ratio(1)	"B" Standard Responses 0	0.5	1	2	Ave.
1.	37	0	700	1		9		0.9
2.	37	150(3)	7000	4		6		0.6
3.	37	150	700			10		1.0
4.	37	0	2000	6	1	3		0.4
5.	37	150	2000	1	1	6	2	1.1
6.	37	0	700	1	1	8		0.9
7.	37	0	7000	2		8		0.8
8.	37	150	2000	3		7		0.7
9.	37	0	7000	1		9		0.9
10.	37	150	700			9	1	1.1
11.	37	0	2000	7	1	2		0.3
12.	37	150	7000	7	1	2		0.3
13.	37	150	700			10		1.0
14.	37	0	700		1	9		1.0
15.	37	150	7000	2		8		0.8

(1) - (3) See Table 9 for explanation.

TABLE 9C. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Run No.	Speed MPH(2)	Load HP	Dilution Ratio(1)	"O" Standard Responses 0	0.5	1	2	Ave.
1.	37	0	700	1		9		0.9
2.	37	150(3)	7000	3		7		0.7
3.	37	150	700	4		6		0.6
4.	37	0	2000	3		7		0.7
5.	37	150	2000	4		6		0.6
6.	37	0	700	2		8		0.8
7.	37	0	7000	3		7		0.7
8.	37	150	2000	5		5		0.5
9.	37	0	7000			10		1.0
10.	37	150	700			9	1	1.1
11.	37	0	2000	3		7		0.7
12.	37	150	7000	3	1	6		0.7
13.	37	150	700	1		9		0.9
14.	37	0	700	2		8		0.8
15.	37	150	7000	3		7		0.7

(1) - (3) See Table 9 for explanation.

TABLE 9D. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 7, 1966

Type Operation: Constant Speed-Idle
Vehicle Speed: See Footnote (2)
Fuel: Reference No. 2

Run No.	Speed MPH(2)	Load HP	Dilution Ratio(1)	"A" Standard Responses 0	0.5	1	Ave.
1.	37	0	700	3		7	0.7
2.	37	150(3)	7000	7		3	0.3
3.	37	150	700			10	1.0
4.	37	0	2000	3		7	0.7
5.	37	150	2000	3		7	0.7
6.	37	0	700	6		4	0.4
7.	37	0	7000	4		6	0.6
8.	37	150	2000	1	1	8	0.9
9.	37	0	7000	7		3	0.3
10.	37	150	700	2		8	0.8
11.	37	0	2000	8		2	0.2
12.	37	150	7000	9		1	0.1
13.	37	150	700	3		7	0.7
14.	37	0	700	4		6	0.6
15.	37	150	7000	7		3	0.3

TABLE 9E. SERIES 8 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Run No.	Speed MPH(2)	Load HP	Dilution Ratio(1)	"P" Standard Responses 0	0.5	1	Ave.
1.	37	0	700	5		5	0.5
2.	37	150(3)	7000	8		2	0.2
3.	37	150	700	7		3	0.3
4.	37	0	2000	9		1	0.1
5.	37	150	2000	5	1	4	0.5
6.	37	0	700	4		6	0.6
7.	37	0	7000	9		1	0.1
8.	37	150	2000	5		5	0.5
9.	37	0	7000	9		1	0.1
10.	37	150	700	5		5	0.5
11.	37	0	2000	9		1	0.1
12.	37	150	7000	8		2	0.2
13.	37	150	700	6		4	0.4
14.	37	0	700	6		4	0.4
15.	37	150	7000	8		2	0.2

(1) - (3) See Table 9 for explanation.

TABLE 10. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Truck-Tractor - Mixed Conditions)

Run No.(1)	Dilution Ratio(2)	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
11.	2000	26	160(3)	6	4	4.4	2	1	1.4	2	1	1.2	1	0	0.6	1	0	0.8
12.	700	29	170(4)	5	4	4.7	2	1	1.5	2	1	1.4	2	0	0.8	1	0	0.7
7.	700	33	160(5)	6	4	5.0	2	1	1.5	2	1	1.2	1	0	0.8	1	0	0.7
10.	700	33	160	6	5	5.5	3	1	2.0	2	1	1.7	2	0	1.0	1	0	0.7
						5.3			1.8			1.5			0.9			0.7
17.	2000	33	180	5	2	4.0	2	0	1.2	2	1	1.1	2	0	0.9	1	0	0.4
6.	2000	Idle(6)	0	6	3	4.3	2	0	1.3	2	0	1.1	2	0	0.8	1	0	0.2
13.	2000	Idle	0	4	2	3.0	2	1	1.2	2	1	1.2	2	0	0.4	1	0	0.1
						3.7			1.3			1.2			0.6			0.2
15.	700	0-8(7)	0	6	4	5.6	3	1	1.8	2	1	1.3	2	0	1.1	2	0	0.9
4.	2000	0-8	0	6	3	4.4	2	1	1.2	1	1	1.0	2	0	1.0	2	0	0.8
5.	700	43-53(8)	0	6	5	5.4	2	1	1.6	3	1	1.3	3	0	1.2	2	0	1.2
9.	2000	43-53	120	6	3	4.6	2	1	1.4	2	1	1.4	2	0	1.0	1	0	0.6
8.	700	52-0(9)	160	5	4	4.6	2	1	1.4	2	1	1.2	1	0	0.9	1	0	0.7
16.	700	52-0	160	7	5	5.6	3	1	2.0	2	1	1.8	2	0	1.1	2	1	1.2
						5.1			1.7			1.5			1.0			1.0
14.	2000	52-0	150	4	4	4.0	1	1	1.0	2	1	1.2	1	0	0.7	1	0	0.4

(1) Runs 1-3 Invalid
(2) Constant Sampling
(3) Constant Speed in 7th gear, 1700 rpm engine speed, open rack
(4) Constant Speed in 7th gear, 1900 rpm engine speed, open rack
(5) Constant speed in 7th gear, 2100 rpm engine speed, open rack
(6) Engine idled at 575 rpm, exposure 30 seconds after 1 minute of operation in 8th gear, 37 mph, 1900 rpm engine speed, 150 hp
(7) Exposure 3 seconds after acceleration from 0 mph in 1st gear following 1 minute idle
(8) Exposure on reaching 50 mph during full rack acceleration from 43 mph to 53 mph in 9th gear
(9) Exposure 5 seconds after closed rack deceleration from 1 minute of open rack 2100 rpm engine operation in 9th gear

TABLE 10A. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS
(Diesel "D" Standards)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 12, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run	Speed	Load	Dilution	"D" Composite Responses							
No.(1)	MPH	HP	Ratio(2)	2	3	4	5	6	7	8	Average
1.	33	160(5)	2000			1	4	3	2		5.6
2.	29	170(4)	700					5	2	3	6.8
3.	29	170(3)	2000				7	3			5.3
4.	0-8	0(7)	2000		1	5	3	1			4.4
5.	43-53	0(8)	700				6	4			5.4
6.	Idle	0(6)	2000		2	4	3	1			4.3
7.	33	160	700			2	6	2			5.0
8.	52-0	160(9)	700			4	6				4.6
9.	43-53	120	2000		1	3	5	1			4.6
10.	33	160	700				5	5			5.5
11.	26	160	2000			7	2	1			4.4
12.	29	170	700			3	7				4.7
13.	Idle	0	2000	3	4	3					3.0
14.	52-0	150	2000			10					4.0
15.	0-8	0	700			2		8			5.6
16.	52-0	160	700				5	4	1		5.6
17.	33	180	2000	1	1	5	3				4.0

(1) - (9) See Table 10 for explanation.

TABLE 10B. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 12, 1966	Fuel: Reference No. 2

Run	Speed	Load	Dilution	"B" Standard Responses				
No. (1)	MPH	HP	Ratio(2)	0	1	2	3	Ave.
1.	33	160(5)	2000		2	5	3	2.1
2.	29	170(4)	700			4	6	2.6
3.	29	170(3)	2000		4	6		1.6
4.	0-8	0(7)	2000		8	2		1.2
5.	43-53	0(8)	700		4	6		1.6
6.	Idle	0(6)	2000	1	5	4		1.3
7.	33	160	700		5	5		1.5
8.	52-0	160(9)	700		6	4		1.4
9.	43-53	120	2000		6	4		1.4
10.	33	160	700		1	8	1	2.0
11.	26	160	2000		6	4		1.4
12.	29	170	700		5	5		1.5
13.	Idle	0	2000		8	2		1.2
14.	52-0	150	2000		10			1.0
15.	0-8	0	700		3	6	1	1.8
16.	52-0	160	700		2	6	2	2.0
17.	33	180	2000	1	6	3		1.2

(1) - (9) See Table 10 for explanation.

TABLE 10C. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 12, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No. (1)	Speed MPH	Load HP	Dilution Ratio(2)	"O" Standard Responses				
				0	1	2	3	Ave.
1.	33	160(5)	2000		2	8		1.8
2.	29	170(4)	700			9	1	2.1
3.	29	170(3)	2000		5	5		1.5
4.	0-8	0(7)	2000		10			1.0
5.	43-53	0(8)	700		8	1	1	1.3
6.	Idle	0(6)	2000	1	7	2		1.1
7.	33	160	700		8	2		1.2
8.	52-0	160(9)	700		8	2		1.2
9.	43-53	120	2000		6	4		1.4
10.	33	160	700		3	7		1.7
11.	26	160	2000		8	2		1.2
12.	29	170	700		6	4		1.4
13.	Idle	0	2000		8	2		1.2
14.	52-0	150	2000		8	2		1.2
15.	0-8	0	700		7	3		1.3
16.	52-0	160	700		2	8		1.8
17.	33	180	2000		9	1		1.1

(1) - (9) See Table 10 for explanation.

TABLE 10D. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 12, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run	Speed	Load	Dilution	"A" Standard Responses				
No.(1)	MPH	HP	Ratio(2)	0	1	2	3	Ave.
1.	33	160(5)	2000	5	4	1		0.6
2.	29	170(4)	700	1	8	1		1.0
3.	29	170(3)	2000	1	9			0.9
4.	0-8	0(7)	2000	1	8	1		1.0
5.	43-53	0(8)	700	1	7	1	1	1.2
6.	Idle	0(6)	2000	3	6	1		0.8
7.	33	160	700	2	8			0.8
8.	52-0	160(9)	700	1	9			0.9
9.	43-53	120	2000	1	8	1		1.0
10.	33	160	700	1	8	1		1.0
11.	26	160	2000	4	6			0.6
12.	29	170	700	4	4	2		0.8
13.	Idle	0	2000	7	2	1		0.4
14.	52-0	150	2000	3	7			0.7
15.	0-8	0	700	1	7	2		1.1
16.	52-0	160	700	1	7	2		1.1
17.	33	180	2000	2	7	1		0.9

(1) - (9) See Table 10 for explanation.

TABLE 10E. SERIES 9 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 12, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No. (1)	Speed MPH	Load HP	Dilution Ratio(2)	"P" Standard Responses			
				0	1	2	Ave.
1.	33	160(5)	2000	3	5	2	0.9
2.	29	170(4)	700	2	7	1	0.9
3.	29	170(3)	2000	4	6		0.6
4.	0-8	0(7)	2000	5	2	3	0.8
5.	43-53	0(8)	700	1	6	3	1.2
6.	Idle	0(6)	2000	8	2		0.2
7.	33	160	700	3	7		0.7
8.	52-0	160(9)	700	3	7		0.7
9.	43-53	120	2000	4	6		0.6
10.	33	160	700	3	7		0.7
11.	26	160	2000	2	8		0.8
12.	29	170	700	3	7		0.7
13.	Idle	0	2000	9	1		0.1
14.	52-0	150	2000	6	4		0.4
15.	0-8	0	700	2	7	1	0.9
16.	52-0	160	700		8	2	1.2
17.	33	180	2000	6	4		0.4

(1) - (9) See Table 10 for explanation.

TABLE 11. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS SUMMARY
(Truck-Tractor - Mixed Conditions)

Run	Dilution	Speed	Load	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
No.	Ratio(1)	MPH	HP	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
8.	700	26(2)	150	5	4	4.4	2	1	1.1	2	0	0.9	1	0	0.9	2	0	0.6
12.	700	26	150	4	3	3.2	1	1	1.0	2	0	1.0	1	0	0.5	1	0	0.3
						3.8			1.1			1.5			0.7			0.5
27.	2000	26	150	4	1	2.6	1	0	0.7	1	0	0.6	2	0	0.5	1	0	0.2
19.	2000	26	150	4	2	2.2	2	0	0.9	1	0	0.6	1	0	0.2	0	0	0
						2.4			0.9			0.6			0.4			0.1
18.	700	29(3)	150	5	1	3.6	2	1	1.4	1	0	0.9	2	0	0.8	1	0	0.2
28.	700	29	150	5	4	4.7	2	1	1.3	2	1	1.3	2	0	1.1	1	0	0.5
						4.2			1.4			1.1			1.0			0.4
10.	2000	29	150	4	2	3.1	1	0	0.9	1	0	0.7	1	0	0.5	1	0	0.4
14.	2000	29	150	4	2	2.7	2	1	1.1	2	0	0.7	2	0	0.4	1	0	0.2
						2.9			1.0			0.7			0.5			0.3
23.	700	33(4)	150	5	2	3.0	2	0	1.1	2	0	0.9	1	0	0.5	2	0	0.9
26.	700	33	150	5	2	4.2	3	1	1.2	1	0	0.8	2	1	1.2	1	0	0.3
						3.6			1.2			0.9			0.9			0.6
5.	2000	33	150	4	3	3.2	1	1	1.0	1	0	0.7	1	0	0.2	1	0	0.5
17.	2000	33	150	2	1	1.7	1	0	0.8	1	0	0.7	1	0	0.4	0	0	0
						2.5			0.9			0.7			0.3			0.3
9.	700	0(5)	160	5	2	3.4	2	1	1.2	1	0	0.8	1	0	0.4	2	0	0.7
15.	700	0	160	4	2	3.5	2	1	1.1	1	0	0.8	1	0	0.6	2	0	0.5
						3.5			1.2			0.8			0.5			0.6
1.	2000	0	160	5	2	3.7	1	0	0.9	1	1	1.0	1	0	0.5	1	0	0.3
22.	2000	0	160	5	2	2.6	1	1	1.0	1	0	0.6	1	0	0.2	0	0	0
						3.2			1.0			0.8			0.4			0.2
3.	700	0-8(6)	160	5	4	4.6	2	1	1.4	1	0	0.9	1	0	0.4	2	0	0.7
11.	700	0-8	160	6	4	5.1	2	1	1.6	2	0	1.3	1	0	0.8	2	0	0.9
						4.9			1.5			1.1			0.6			0.8

TABLE 11. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Truck-Tractor - Mixed Conditions)

Run	Dilution	Speed	Load	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
No.	Ratio	MPH	HP	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
16.	2000	0-8	160	2	1	1.7	1	0	0.7	1	0	0.7	1	0	0.3	2	0	0.3
20.	2000	0-8	160	5	1	3.5	3	0	1.3	1	0	0.8	1	0	0.4	1	0	0.1
						2.6			1.0			0.8			0.4			0.2
6.	700	43-53(7)	120	5	4	4.6	1	1	1.0	2	0	0.8	1	0	0.4	1	0	0.6
21.	700	43-53	120	6	4	5.1	2	0	1.8	2	0	1.2	1	0	0.3	2	0	1.0
25.	700	43-53	120	5	2	4.0	2	0	1.4	2	0	1.0	1	0	0.9	1	0	0.7
						4.6			2.1			1.4			0.5			0.8
13.	2000	43-53	120	4	2	3.0	1	1	1.0	1	0	0.7	1	0	0.3	1	0	0.1
4.	700	52-0(8)	160	6	4	5.1	2	1	1.6	2	0	1.2	1	0	0.7	2	0	0.8
24.	700	52-0	160	6	5	5.7	3	1	2.0	2	1	1.5	2	0	0.4	2	0	1.2
						5.4			1.8			1.4			0.6			1.0
2.	2000	52-0	160	5	3	4.3	1	1	1.0	1	0	0.9	1	0	0.5	2	0	0.6
7.	2000	52-0	160	3	2	2.4	1	1	1.0	1	0	0.6	1	0	0.5	1	0	0.1
						3.5			1.0			0.8			0.5			0.4

(1) Constant Sampling
(2) Constant Speed in 7th gear, 1700 rpm engine speed, open rack
(3) Constant Speed in 7th gear, 1900 rpm engine speed, open rack
(4) Constant speed in 7th gear, 2100 rpm engine speed, open rack
(5) Engine idled at 575 rpm, exposure 30 seconds after 1 minute of operation in 8th gear, 37 mph, 1900 rpm engine speed, 150 hp
(6) Exposure 3 seconds after acceleration from 0 mph in 1st gear following 1 minute idle
(7) Exposure on reaching 50 mph during full rack acceleration from 43 mph to 53 mph in 9th gear
(8) Exposure 5 seconds after closed rack deceleration from 1 minute of open rack 2100 rpm engine operation in 9th gear

TABLE 11A. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS

(Diesel "D" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 13, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"D" Composite Responses						
				1	2	3	4	5	6	Ave.
1.	0(5)	160	2000		1	3	4	2		3.7
2.	52-0(8)	160	2000			2	3	5		4.3
3.	0-8(6)	160	700				4	6		4.6
4.	52-0	160	700				1	7	2	5.1
5.	33(4)	150	2000			8	2			3.2
6.	43-53(7)	120	700				4	6		4.6
7.	52-0	160	2000		6	4				2.4
8.	26(3)	150	700				6	4		4.4
9.	33	160	700		1	5	3	1		3.4
10.	29	150	2000		1	7	2			3.1
11.	0-8	150	700				3	3	4	5.1
12.	26(2)	150	700			8	2			3.2
13.	43-53	150	2000		1	8	1			3.0
14.	29	150	2000		4	5	1			2.7
15.	0	160	700		1	3	6			3.5
16.	0-8	0	2000	3	7					1.7
17.	33	150	2000	3	7					1.7
18.	29	150	700	1		3	4	2		3.6
19.	26	150	2000		9		1			2.2
20.	0-8	0	2000	1	1	1	6	1		3.5
21.	43-53	120	700				1	7	2	5.1
22.	0	160	2000		7	1	1	1		2.6
23.	33	150	700		1	6		2		3.0
24.	52-0	150	700					3	7	5.7
25.	43-53	120	700		1		5	4		4.0
26.	33	150	700		1	1	3	5		4.2
27.	26	150	2000	1	4	3	2			2.6
28.	29	150	700				3	7		4.7

(1) - (8) See Table 11 for explanation.

TABLE 11B. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 13, 1966	Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"B" Standard Responses 0	1	2	3	Ave.
1.	0(5)	160	2000	1	9			0.9
2.	52-0(8)	160	2000		10			1.0
3.	0-8(6)	160	700		6	4		1.4
4.	52-0	160	700		4	6		1.6
5.	33(4)	150	2000		10			1.0
6.	43-53(7)	120	700		8	2		1.2
7.	52-0	160	2000		10			1.0
8.	26(3)	150	700		9	1		1.1
9.	33	160	700		8	2		1.2
10.	29	150	2000	1	9			0.9
11.	0-8	150	700		4	6		1.6
12.	26(2)	150	700		10			1.0
13.	43-53	150	2000		10			1.0
14.	29	150	2000		9	1		1.1
15.	0	160	700		9	1		1.1
16.	0-8	0	2000	3	7			0.7
17.	33	150	2000	2	8			0.8
18.	29	150	700		6	4		1.4
19.	26	150	2000	2	7	1		0.9
20.	0-8	0	2000	1	6	2	1	1.3
21.	43-53	120	700	1		9		1.8
22.	0	160	2000	3	7			0.7
23.	33	150	700	1	7	2		1.1
24.	52-0	150	700		1	8	1	2.0
25.	43-53	120	700	1	4	5		1.4
26.	33	150	700		9		1	1.2
27.	26	150	2000	3	7			0.7
28.	29	150	700	1	5	4		1.3

(1) - (8) See Table 11 for explanation.

TABLE 11C. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 13, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio (1)	"O" Standard Responses			
				0	1	2	Ave.
1.	0(5)	160	2000		10		1.0
2.	52-0(8)	160	2000	1	9		0.9
3.	0-8 (6)	160	700	1	9		0.9
4.	52-0	160	700	1	6	3	1.2
5.	33 (4)	150	2000	3	7		0.7
6.	43-53(7)	120	700	3	6	1	0.8
7.	52-0	160	2000	3	7		0.7
8.	26(3)	150	700	2	7	1	0.9
9.	33	160	700	2	8		0.8
10.	29	150	2000	3	7		0.7
11.	0-8	150	700	1	5	4	1.3
12.	26(2)	150	700	1	8	1	1.0
13.	43-53	150	2000	3	7		0.7
14.	29	150	2000	4	5	1	0.7
15.	0	160	700	2	8		0.8
16.	0-8	0	2000	3	7		0.7
17.	33	150	2000	3	7		0.7
18.	29	150	700	1	9		0.9
19.	26	150	2000	4	6		0.6
20.	0-8	0	2000	2	8		0.8
21.	43-53	120	700	1	6	3	1.2
22.	0	160	2000	4	6		0.6
23.	33	150	700	2	7	1	0.9
24.	52-0	150	700		5	5	1.5
25.	43-53	120	700	1	8	1	1.0
26.	33	150	700	2	8		0.8
27.	26	150	2000	4	6		0.6
28.	29	150	700		7	3	1.3

(1) - (8) See Table 11 for explanation.

TABLE 11D. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 13, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"A" Standard Responses 0	1	2	Average
1.	0(5)	160	2000	5	5		0.5
2.	52-0(8)	160	2000	5	5		0.5
3.	0-8(6)	160	700	6	4		0.4
4.	52-0	160	700	3	7		0.7
5.	33(4)	150	2000	8	2		0.2
6.	43-53(7)	120	700	6	4		0.4
7.	52-0	160	2000	5	5		0.5
8.	26(3)	150	700	1	9		0.9
9.	33	160	700	6	4		0.4
10.	29	150	2000	5	5		0.5
11.	0-8	150	700	2	8		0.8
12.	26(2)	150	700	5	5		0.5
13.	43-53	150	2000	7	3		0.3
14.	29	150	2000	7	2	1	0.4
15.	0-8	160	700	4	6		0.6
16.	0-8	0	2000	7	3		0.3
17.	33	150	2000	6	4		0.4
18.	29	150	700	3	6	1	0.8
19.	26	150	2000	8	2		0.2
20.	0-8	0	2000	6	4		0.4
21.	43-53	120	700	1	9		0.9
22.	0	160	2000	8	2		0.2
23.	33	150	700	5	5		0.5
24.	52-0	150	700	8		2	0.4
25.	43-53	120	700	1	9		0.9
26.	33	150	700		8	2	1.2
27.	26	150	2000	6	3	1	0.5
28.	29	150	700	1	7	2	1.1

(1) - (8) See Table 11 for explanation.

TABLE 11E. SERIES 10 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 13, 1966	Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"P" Standard Responses 0	1	2	Ave.
1.	0(5)	160	2000	7	3		0.3
2.	52-0(8)	160	2000	6	2	2	0.6
3.	0-8(6)	160	700	5	3	2	0.7
4.	52-0	160	700	3	6	1	0.8
5.	33(4)	150	2000	5	5		0.5
6.	43-53(7)	120	700	4	6		0.6
7.	52-0	160	2000	9	1		0.1
8.	26(3)	150	700	5	4	1	0.6
9.	33	160	700	4	5	1	0.7
10.	29	150	2000	6	4		0.4
11.	0-8	150	700	4	3	3	0.9
12.	26(2)	150	700	7	3		0.3
13.	43-53	150	2000	9	1		0.1
14.	29	150	2000	8	2		0.2
15.	0	160	700	6	3	1	0.5
16.	0-8	0	2000	8	1	1	0.3
17.	33	150	2000	10			0
18.	29	150	700	8	2		0.2
19.	26	150	2000	10			0
20.	0-8	0	2000	9	1		0.1
21.	43-53	120	700	3	4	3	1.0
22.	0	160	2000	10			0
23.	33	150	700	3	5	2	0.9
24.	52-0	150	700	1	6	3	1.2
25.	43-53	120	700	3	7		0.7
26.	33	150	700	7	3		0.3
27.	26	150	2000	8	2		0.2
28.	29	150	700	5	5		0.5

(1) - (8) See Table 11 for explanation.

TABLE 12. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Truck-Tractor - Mixed Conditions)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite Max.	"D" Composite Min.	"D" Composite Ave.	"B" Burnt Max.	"B" Burnt Min.	"B" Burnt Ave.	"O" Oily Max.	"O" Oily Min.	"O" Oily Ave.	"A" Aromatic Max.	"A" Aromatic Min.	"A" Aromatic Ave.	"P" Pungent Max.	"P" Pungent Min.	"P" Pungent Ave.
3.	700	26(2)	150	6	3	4.5	2	1	1.2	1	0	0.9	1	0	0.6	1	0	0.3
27.	700	26	150	5	2	3.5	1	0	0.8	1	0	0.8	1	0	0.5	1	0	0.4
						4.0			1.0			0.9			0.6			0.4
10.	2000	26	150	2	1	1.7	1	0	0.5	1	0	0.2	1	0	0.5	1	0	0.1
18.	2000	26	150	3	1	2.0	1	0	0.7	1	0	0.5	2	0	0.7	1	0	0.2
						1.9			0.6			0.4			0.6			0.2
9.	700	29(3)	150	5	3	4.4	2	1	1.5	2	1	0.7	1	0	0.7	2	0	0.7
19.	700	29	150	4	3	3.7	1	1	1.0	1	0	0.9	2	0	0.9	1	0	0.4
						4.1			1.3			0.9			0.9			0.6
1.	2000	29	150	5	3	3.9	2	0.5	1.0	1	0	0.7	1	0	0.6	1	0	0.2
5.	2000	29	150	3	1	2.1	1	0	0.7	1	0	0.4	1	0	0.4	0	0	0
						3.0			0.9			0.6			0.5			0.1
14.	700	33(4)	150	4	3	3.4	2	1	1.1	2	0	1.0	1	0	0.4	1	0	0.1
17.	700	33	150	4	2	3.0	1	0	0.8	1	0	0.8	2	0	0.9	1	0	0.3
						3.2			1.0			0.9			0.7			0.2
8.	2000	33	150	5	3	4.4	1	0	0.7	2	0	0.7	2	0	0.7	2	0	0.3
24.	2000	33	150	3	2	2.5	1	0	0.8	1	0	0.9	1	0	0.4	0	0	0
						3.5			0.8			0.9			0.6			0.2
6.	700	0(5)	0	5	4	4.1	2	0	1.1	2	0	1.0	2	0	0.8	1	0	0.1
28.	700	0	0	4	2	2.9	1	0	0.8	1	0	0.8	2	0	0.4	1	0	0.6
						3.5			1.0			0.9			0.6			0.4
13.	2000	0	0	4	1	2.3	1	0	0.9	1	0	0.5	1	0	0.4	1	0	0.3
20.	2000	0	0	4	1	2.5	1	0	0.8	1	0	0.7	1	0	0.5	1	0	0.3
						2.4			0.9			0.6			0.5			0.3
2.	700	0-8(6)	0	5	2	3.5	1	1	1.0	1	0	0.7	1	0	0.6	1	0	0.5
22.	700	0-8	0	5	3	3.0	2	0	1.0	2	0	1.0	1	0	0.9	2	0	0.8
						3.3			1.0			0.9			0.8			0.7

TABLE 12. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2

(Truck-Tractor - Mixed Conditions)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
7.	2000	0-8	0	3	2	2.7	1	0	0.6	1	0	0.9	2	0	0.9	2	0	0.4
11.	2000	0-8	0	2	1	1.7	1	0	0.5	1	0	0.5	1	0	0.5	1	0	0.4
						2.2			0.6			0.7			0.7			0.4
12.	700	43-53(7)	0	5	3	4.0	1	1	1.0	2	0	1.1	1	0	0.5	2	0	0.8
16.	700	43-53	0	5	3	4.2	2	1	1.4	2	0	0.9	1	0	0.6	1	0	0.5
25.	700	43-53	0	4	2	3.6	1	0	0.8	2	0	0.9	1	0	0.8	1	0	0.5
						3.9			1.6			1.0			0.6			0.6
4.	2000	43-53	0	4	1	2.9	1	0	0.7	1	0	0.8	1	0	0.6	0	0	0
15.	700	52-0(8)	0	6	5	5.3	2	1	1.6	2	1	1.3	1	0	0.6	2	0	0.7
23.	700	52-0	0	6	5	5.2	2	1	1.9	2	1	1.4	2	0	1.0	2	0	0.7
						5.3			1.8			1.4			0.8			0.7
21.	2000	52-0	0	5	3	3.8	1	1	1.0	1	1	1.0	1	0	0.4	1	0	0.5
26.	2000	52-0	0	5	4	4.1	1	1	1.0	2	0	1.0	1	0	0.7	1	0	0.5
						4.0			1.0			1.0			0.6			0.5

(1) Constant Sampling
(2) Constant Speed in 7th gear, 1700 rpm engine speed, open rack
(3) Constant Speed in 7th gear, 1900 rpm engine speed, open rack
(4) Constant Speed in 7th gear, 2100 rpm engine speed, open rack
(5) Engine idled at 575 rpm, exposure 30 seconds after 1 minute of operation in 8th gear, 37 mph, 1900 rpm engine speed, 150 hp
(6) Exposure 3 seconds after acceleration from 0 mph in 1st gear following 1 minute idle
(7) Exposure on reaching 50 mph during full rack acceleration from 43 mph to 53 mph in 9th gear
(8) Exposure 5 seconds after closed rack deceleration from 1 minute of open rack 2100 rpm engine operation in 9th gear

TABLE 12A. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS
(Diesel "D" Standard)

Vehicle: Truck-Tractor	**Type Operation:** Mixed Conditions
Sample Method: Constant	**Vehicle Speed:** See Below
Date: December 14, 1966	**Fuel:** Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	(Diesel "D" Standard) 1	2	3	4	5	6	Ave.
1.	29(3)	150	2000			5	1	4		3.9
2.	0-8(6)	0	700		2	2	5	1		3.5
3.	26(2)	150	700			2	3	3	2	4.5
4.	43-53(7)	120	2000	1	4		5			2.9
5.	29	150	2000	2	5	3				2.1
6.	0(5)	0	700	1			5	4		4.1
7.	0-8	0	2000		3	7				2.7
8.	33(4)	150	2000			2	2	6		4.4
9.	29	150	700			2	2	6		4.4
10.	26	150	2000	3	7					1.7
11.	0-8	0	2000	3	7					1.7
12.	43-53	120	700			1	8	1		4.0
13.	0	0	2000	3	3	2	2			2.3
14.	33	150	700			6	4			3.4
15.	52-0(8)	160	700					7	3	5.3
16.	43-53	120	700			1	1	8		4.2
17.	33	150	700		2	6	2			3.0
18.	26	150	2000	2	6	2				2.0
19.	29	150	700			3	7			3.7
20.	0	0	2000	3	1	4	2			2.5
21.	52-0	160	2000			3	6	1		3.8
22.	0-8	0	700			3	4	3		3.0
23.	52-0	160	700					3	7	5.2
24.	33	150	2000		5	5				2.5
25.	43-53	120	700		1	2	7			3.6
26.	52-0	160	2000				9	1		4.1
27.	26	150	700		2	3	3	2		3.5
28.	0	0	700		3	5	2			2.9

(1) - (8) See Table 12 for explanation.

TABLE 12B. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 14, 1966	Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"B" Standard Responses				
				0	0.5	1	2	Ave.
1.	29(3)	150	2000		2	7	1	1.0
2.	0-8(6)	0	700			10		1.0
3.	26(2)	150	700			8	2	1.2
4.	43-53(7)	120	2000	3		7		0.7
5.	29	150	2000	2	2	6		0.7
6.	0(5)	0	700	1		7	2	1.1
7.	0-8	0	2000	4		6		0.6
8.	33(4)	150	2000	3		7		0.7
9.	29	150	700			5	5	1.5
10.	26	150	2000	5		5		0.5
11.	0-8	0	2000	5		5		0.5
12.	43-53	120	700			10		1.0
13.	0	0	2000	0		9		0.9
14.	33	150	700			9	1	1.1
15.	52-0(8)	160	700			4	6	1.6
16.	43-53	120	700			6	4	1.4
17.	33	150	700	2		8		0.8
18.	26	150	2000	3		7		0.7
19.	29	150	700			10		1.0
20.	0	0	2000	2		8		0.8
21.	52-0	160	2000			10		1.0
22.	0-8	120	700	1		8	1	1.0
23.	52-0	160	700			1	9	1.9
24.	33	150	2000	2		8		0.8
25.	43-53	120	700	2		8		0.8
26.	52-0	160	2000			10		1.0
27.	26	150	700	2		8		0.8
28.	0	0	700	2		8		0.8

(1) - (8) See Table 12 for explanation.

TABLE 12C. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS
(Oily "O" Standard)

Vehicle: Truck-Tractor	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 14, 1966	Fuel: Reference No. 2

Run	Speed	Load	Dilution	"O" Standard Responses			
No.	MPH	HP	Ratio(1)	0	1	2	Ave.
1.	29(3)	150	2000	3	7		0.7
2.	0-8(6)	0	700	3	7		0.7
3.	26(2)	150	700	1	9		0.9
4.	43-53(7)	120	2000	2	8		0.8
5.	29	150	2000	6	4		0.4
6.	0(5)	0	700	1	8	1	1.0
7.	0-8	0	2000	1	9		0.9
8.	33(4)	150	2000	4	5	1	0.7
9.	29	150	700	4	5	1	0.7
10.	26	150	2000	8	2		0.2
11.	0-8	0	2000	5	5		0.5
12.	43-53	120	700	1	7	2	1.1
13.	0	0	2000	5	5		0.5
14.	33	150	700	1	8	1	1.0
15.	52-0(8)	160	700		7	3	1.3
16.	43-53	120	700	2	7	1	0.9
17.	33	150	700	2	8		0.8
18.	26	150	2000	5	5		0.5
19.	29	150	700	1	9		0.9
20.	0	0	2000	3	7		0.7
21.	52-0	160	2000		10		1.0
22.	0-8	0	700	2	6	2	1.0
23.	52-0	160	700		6	4	1.4
24.	33	150	2000	1	9		0.9
25.	43-53	120	700	2	7	1	0.9
26.	52-0	160	2000	1	8	1	1.0
27.	26	150	700	2	8		0.8
28.	0	0	700	2	8		0.8

(1) - (8) See Table 12 for explanation.

TABLE 12D. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 14, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"A" Standard Responses 0	1	2	Ave.
1.	29(3)	150	2000	4	6		0.6
2.	0-8(6)	0	700	4	6		0.6
3.	26(2)	150	700	4	5	1	0.7
4.	43-53(7)	120	2000	4	6		0.6
5.	29	150	2000	6	4		0.4
6.	0(5)	0	700	4	4	2	0.8
7.	0-8([illegible])	0	2000	3	5	2	0.9
8.	33(4)	150	2000	4	5	1	0.7
9.	29	150	700	3	7		0.7
10.	26	150	2000	5	5		0.5
11.	0-8	0	2000	5	5		0.5
12.	43-53	120	700	5	5		0.5
13.	0	0	2000	6	4		0.4
14.	33	150	700	6	4		0.4
15.	52-0(8)	160	700	4	6		0.6
16.	43-53	120	700	4	6		0.6
17.	33	150	700	2	7	1	0.9
18.	26	150	2000	4	5	1	0.7
19.	29	150	700	2	7	1	0.9
20.	0	0	2000	5	5		0.5
21.	52-0	160	2000	6	4		0.4
22.	0-8	0	700	1	9		0.9
23.	52-0	160	700	2	6	2	1.0
24.	33	150	2000	6	4		0.4
25.	43-53	120	700	2	8		0.8
26.	52-0	160	2000	3	7		0.7
27.	26	150	700	5	5		0.5
28.	0	0	700	7	2	1	0.4

(1) - (8) See Table 12 for explanation.

TABLE 12E. SERIES 11 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 14, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"P" Standard Responses			
				- 0	1	2	Ave.
1.	29(3)	150	2000	8	2		0.2
2.	0-8(6)	0	700	5	5		0.5
3.	26(2)	150	700	7	3		0.3
4.	43-53(7)	120	2000	10			0
5.	29	150	2000	10			0
6.	0(5)	0	700	9	1		0.1
7.	0-8	0	2000	7	2	1	0.4
8.	33(4)	150	2000	8	1	1	0.3
9.	29	150	700	4	5	1	0.7
10.	26	150	2000	9	1		0.1
11.	0-8	0	2000	6	4		0.4
12.	43-53	120	700	4	4	2	0.8
13.	0	0	2000	7	3		0.3
14.	33	150	700	9	1		0.1
15.	52-0(8)	160	700	5	3	2	0.7
16.	43-53	120	700	5	5		0.5
17.	33	150	700	7	3		0.3
18.	26	150	2000	8	2		0.2
19.	29	150	700	6	4		0.4
20.	0	0	2000	7	3		0.3
21.	52-0	160	2000	5	5		0.5
22.	0-8	0	700	3	6	1	0.8
23.	52-0	160	700	4	5	1	0.7
24.	33	150	2000	10			0
25.	43-53	120	700	5	5		0.5
26.	52-0	160	2000	5	5		0.5
27.	26	150	700	6	4		0.4
28.	0	0	700	4	6		0.6

(1) - (8) See Table 12 for exposure.

TABLE 13. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS SUMMARY

(Truck-Tractor - Mixed Conditions)

Run	Dilution	Speed	Load	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
No.	Ratio(1)	MPH	HP	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
2.	700	26(2)	150	4	2	3.6	2	0	0.9	1	0	0.9	1	0	0.6	1	0	0.2
20.	700	26	150	4	2	3.0	1	0	0.6	1	0	0.8	2	0	0.8	1	0	0.1
						3.3			0.8			0.9			0.7			0.2
4.	2000	26	150	5	2	3.7	2	0	1.1	1	0	0.9	1	0	0.6	1	0	0.3
18.	2000	26	150	4	2	2.8	1	0	0.8	2	0	0.6	1	0	0.5	0	0	0
						3.3			1.0			0.8			0.6			0.2
10.	700	29(3)	150	4	2	2.8	1	0	0.7	2	0	0.7	1	0	0.7	1	0	0.2
16.	700	29	150	4	3	3.2	1	0	0.7	1	0	0.6	2	0	1.0	1	0	0.1
						3.0			0.7			0.7			0.9			0.2
9.	2000	29	150	4	2	2.2	1	0	0.4	2	0	1.0	1	0	0.6	0	0	0
21.	2000	29	150	3	2	2.3	1	0	0.6	2	0	1.0	2	0	0.4	1	0	0.1
						2.3			0.5			1.0			0.5			0.1
8.	700	33(4)	150	4	3	3.3	2	0	0.9	1	0	0.5	1	0	0.6	1	0	0.5
25.	700	33	150	5	4	4.8	2	1	1.6	1	0	0.9	2	0	0.9	1	0	0.4
						4.1			1.3			0.7			0.8			0.5
5.	2000	33	150	5	4	4.2	1	1	1.0	2	1	1.1	1	0	0.4	1	0	0.4
12.	2000	33	150	5	2	2.7	2	0	0.5	1	0	0.7	1	0	0.8	1	0	0.2
						3.5			0.8			0.9			0.6			0.3
3.	700	0(5)	0	5	2	4.3	2	0	1.1	2	1	1.1	1	0	0.6	1	0	0.4
22.	700	0	0	5	3	4.1	2	0	1.1	2	0	1.0	1	0	0.6	2	0	0.4
						4.2			1.1			1.1			0.6			0.4
15.	2000	0	0	4	2	3.3	2	0	1.0	1	0	0.8	2	0	0.6	1	0	0.4
28.	2000	0	0	2	1	1.5	1	0	0.4	2	0	0.9	1	0	0.2	1	0	0.1
						2.4			0.7			0.9			0.4			0.3
11.	700	0-8(6)	0	5	3	4.6	2	1	1.4	1	0	0.9	2	0	0.9	1	0	0.6
17.	700	0-8	0	5	3	3.9	2	0	0.9	2	0	0.9	2	0	1.0	2	0	0.5
						4.3			1.2			0.9			0.9			0.6

TABLE 13. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS SUMMARY Page 2
(Truck-Tractor - Mixed Conditions)

Run No.	Dilution Ratio(1)	Speed MPH	Load HP	"D" Composite			"B" Burnt			"O" Oily			"A" Aromatic			"P" Pungent		
				Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
24.	2000	0-8	0	4	2	2.6	2	0	0.5	1	0	0.9	1	0	0.7	1	0	0.1
27.	2000	0-8	0	4	2	2.7	1	0	0.7	1	0	0.7	1	0	0.6	1	0	0.2
						2.7			0.6			0.8			0.7			0.2
13.	700	43-53(7)	120	4	3	3.8	2	1	1.1	1	0	0.7	2	0	1.0	1	0	0.1
26.	700	43-53	120	3	2	2.6	1	0	0.6	1	0	0.8	1	0	0.8	1	0	0.1
						3.2			0.9			0.8			0.9			0.1
1.	2000	43-53	120	5	3	4.2	2	1	1.1	2	1	1.1	1	0	0.6	1	0	0.4
7.	2000	43-53	120	5	4	4.3	2	1	1.1	1	0	0.9	2	0	0.8	1	0	0.2
						4.3			1.1			1.0			0.7			0.3
6.	700	52-0(8)	160	6	5	5.5	3	2	2.1	2	1	1.1	1	0	0.9	2	0	1.0
19.	700	52-0	160	6	4	5.0	2	1	1.7	2	1	1.3	1	0	0.8	1	0	0.5
						5.3			1.9			1.2			0.9			0.8
14.	2000	52-0	160	5	4	4.6	2	1	1.2	1	0	0.9	2	0	0.9	1	0	0.3
23.	2000	52-0	160	4	2	2.9	1	0	0.9	2	0	0.9	1	0	0.5	0	0	0
						3.8			1.1			0.9			0.7			0.2

(1) Constant Sampling
(2) Constant Speed in 7th gear, 1700 rpm engine speed, open rack
(3) Constant Speed in 7th gear, 1900 rpm engine speed, open rack
(4) Constant Speed in 7th gear, 2100 rpm engine speed, open rack
(5) Engine idled at 575 rpm, exposure 30 seconds after 1 minute of operation in 8th gear, 37 mph, 1900 rpm engine speed, 150 hp
(6) Exposure 3 seconds after acceleration from 0 mph in 1st gear following 1 minute idle
(7) Exposure on reaching 50 mph during full rack acceleration from 43 mph to 53 mph in 9th gear
(8) Exposure 5 seconds after closed rack deceleration from 1 minute of open rack 2100 rpm engine operation in 9th gear

TABLE 13A. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS

(Diesel Composite "D" Standard)

Vehicle: Truck-Tractor	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 15, 1966	Fuel: Reference No. 2

Run	Speed	Load	Dilution	"D" Composite Responses						
No.	MPH	HP	Ratio(1)	1	2	3	4	5	6	Ave.
1.	43-53(7)	120	2000			1	6	3		4.2
2.	26(2)	150	700		1	2	7			3.6
3.	0(5)	0	700		1		4	5		4.3
4.	26	150	2000		1	3	4	2		3.7
5.	33(4)	150	2000				8	2		4.2
6.	52-0	160	700					5	5	5.5
7.	43-53	120	2000				7	3		4.3
8.	33	150	700			7	3			3.3
9.	29(3)	150	2000		9		1			2.2
10.	29	150	700		4	4	2			2.8
11.	0-8(6)	0	700			1	2	7		4.6
12.	33	150	2000		5	4		1		2.7
13.	43-53	120	700			2	8			3.8
14.	52-0(8)	160	2000				4	6		4.6
15.	0	0	2000		3	1	6			3.3
16.	29	150	700			8	2			3.2
17.	0-8	0	700			2	7	1		3.9
18.	26	150	2000		4	4	2			2.8
19.	52-0	160	700				1	8	1	5.0
20.	26	150	700		4	2	4			3.0
21.	29	150	2000		7	3				2.3
22.	0	0	700			1	7	2		4.1
23.	52-0	160	2000		3	5	2			2.9
24.	0-8	0	2000		6	2	2			2.6
25.	33	150	700				2	8		4.8
26.	43-53	120	700		4	6				2.6
27.	0-8	0	2000		5	3	2			2.7
28.	0	0	2000	5	5					1.5

(1) - (8) See Table 13 for explanation.

TABLE 13B. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS
(Burnt-Smoky "B" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 15, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"B" Standard Responses				
				0	1	2	3	Ave.
1.	43-53(7)	120	2000		9	1		1.1
2.	26(2)	150	700	2	7	1		0.9
3.	0(5)	0	700	3	3	4		1.1
4.	26	150	2000	1	7	2		1.1
5.	33(4)	150	2000		10			1.0
6.	52-0	160	700			9	1	2.1
7.	43-53	120	2000		9	1		1.1
8.	33	150	700	2	7	1		0.9
9.	29(3)	150	2000	6	4			0.4
10.	29	150	700	3	7			0.7
11.	0-8(6)	0	700		6	4		1.4
12.	33	150	2000	6	3	1		0.5
13.	43-53	120	700		9	1		1.1
14.	52-0(8)	160	2000		8	2		1.2
15.	0	0	2000	1	8	1		1.0
16.	29	150	700	3	7			0.7
17.	0-8	0	700	2	7	1		0.9
18.	26	150	2000	2	8			0.8
19.	52-0	160	700		3	7		1.7
20.	26	150	700	4	6			0.6
21.	29	150	2000	4	6			0.6
22.	0	0	700	1	7	2		1.1
23.	52-0	160	2000	1	9			0.9
24.	0-8	0	2000	6	3	1		0.5
25.	33	150	700		4	6		1.6
26.	43-53	0	700	4	6			0.6
27.	0-8	0	2000	3	7			0.7
28.	0	0	2000	6	4			0.4

(1) - (8) See Table 13 for explanation.

TABLE 13C. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS

(Oily "O" Standard)

Vehicle: Truck-Tractor	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 15, 1966	Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"O" Standard Responses			
				0	1	2	Ave.
1.	43-53(7)	120	2000		9	1	1.1
2.	26(2)	150	700	1	9		0.9
3.	0(5)	0	700		9	1	1.1
4.	26	150	2000	1	9		0.9
5.	33(4)	150	2000		9	1	1.1
6.	52-0	160	700		9	1	1.1
7.	43-53	120	2000	1	9		0.9
8.	33	150	700	5	5		0.5
9.	29(3)	150	2000	1	8	1	1.0
10.	29	150	700	4	5	1	0.7
11.	0-8(6)	0	700	1	9		0.9
12.	33	150	2000	3	7		0.7
13.	43-53	120	700	3	7		0.7
14.	52-0(8)	160	2000	1	9		0.9
15.	0	0	2000	2	8		0.8
16.	29	150	700	4	6		0.6
17.	0-8	0	700	2	7	1	0.9
18.	26	150	2000	5	4	1	0.6
19.	52-0	160	700		7	3	1.3
20.	26	150	700	2	8		0.8
21.	29	150	2000	1	8	1	1.0
22.	0	0	700	1	8	1	1.0
23.	52-0	160	2000	2	7	1	0.9
24.	0-8	0	2000	1	9		0.9
25.	33	150	700	1	9		0.9
26.	43-53	0	700	2	8		0.8
27.	0-8	0	2000	4	5	1	0.7
28.	0	0	2000	3	5	2	0.9

(1) - (8) See Table 13 for explanation.

TABLE 13D. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS
(Aromatic "A" Standard)

Vehicle: Truck-Tractor
Sample Method: Constant
Date: December 15, 1966

Type Operation: Mixed Conditions
Vehicle Speed: See Below
Fuel: Reference No. 2

Run No.	Speed MPH	Load HP	Dilution Ratio(1)	"A" Standard Responses 0	1	2	Ave.
1.	43-53(7)	120	2000	4	6		0.6
2.	26(2)	150	700	4	6		0.6
3.	0(5)	0	700	4	6		0.6
4.	26	150	2000	4	6		0.6
5.	33(4)	150	2000	7	2	1	0.4
6.	52-0	160	700	1	9		0.9
7.	43-53	120	2000	3	6	1	0.8
8.	33	150	700	4	6		0.6
9.	29(3)	150	2000	4	6		0.6
10.	29	150	700	3	7		0.7
11.	0-8(6)	0	700	2	7	1	0.9
12.	33	150	2000	2	8		0.8
13.	43-53	120	700	3	4	3	1.0
14.	52-0(8)	160	2000	2	7	1	0.9
15.	0	0	2000	5	4	1	0.6
16.	29	150	700	1	8	1	1.0
17.	0-8	0	700	1	8	1	1.0
18.	26	150	2000	5	5		0.5
19.	52-0	160	700	2	8		0.8
20.	26	150	700	4	4	2	0.8
21.	29	150	2000	7	2	1	0.4
22.	0	0	700	4	6		0.6
23.	52-0	160	2000	5	5		0.5
24.	0-8	0	2000	3	7		0.7
25.	33	150	700	2	7	1	0.9
26.	43-53	0	700	2	8		0.8
27.	0-8	0	2000	4	6		0.6
28.	0	0	2000	8	2		0.2

(1) - (8) See Table 13 for explanation.

TABLE 13E. SERIES 12 PROCEDURAL DEVELOPMENT RESULTS
(Pungent "P" Standard)

Vehicle: Truck-Tractor	Type Operation: Mixed Conditions
Sample Method: Constant	Vehicle Speed: See Below
Date: December 15, 1966	Fuel: Reference No. 2

Run	Speed	Load	Dilution	"P" Standard Responses			
No.	MPH	HP	Ratio(1)	0	1	2	Ave.
1.	43-53(7)	120	2000	6	4		0.4
2.	26(2)	150	700	8	2		0.2
3.	0(5)	0	700	6	4		0.4
4.	26	150	2000	7	3		0.3
5.	33(4)	150	2000	6	4		0.4
6.	52-0	160	700	1	8	1	1.0
7.	43-53	120	2000	8	2		0.2
8.	33	150	700	5	5		0.5
9.	29(3)	150	2000	10			0
10.	29	150	700	8	2		0.2
11.	0-8(6)	0	700	4	6		0.6
12.	33	150	2000	8	2		0.2
13.	43-53	120	700	9	1		0.1
14.	52-0(8)	160	2000	7	3		0.3
15.	0	0	2000	6	4		0.4
16.	29	150	700	9	1		0.1
17.	0-8	0	700	6	3	1	0.5
18.	26	150	2000	10			0
19.	52-0	160	700	5	5		0.5
20.	26	150	700	9	1		0.1
21.	29	150	2000	9	1		0.1
22.	0	0	700	7	2	1	0.4
23.	52-0	160	2000	10			0
24.	0-8	0	2000	9	1		0.1
25.	33	150	700	6	4		0.4
26.	43-53	0	700	9	1		0.1
27.	0-8	0	2000	8	2		0.2
28.	0	0	2000	9	1		0.1

(1) - (8) See Table 13 for explanation.

TABLE 14 REPRESENTATIVE TRUCK-TRAILER EXHAUST SAMPLE AND STACK TEMPERATURES OBTAINED DURING SERIES 11 MIXED CONDITIONS

Run No.	Type Operation	Speed MPH	Load HP	Engine RPM	Gear No.	Dilution Ratio(1)	Representative(9) Temperatures F.	
							Sample	Stack
4.	Accel.	50(7)	120	2200	9	2000	70	670
5.	Const. Speed	29(3)	150	1900	7	2000	75	700
6.	Idle	0(5)	0	575	N	700	100	610
7.	Idle-Accel.	5.5(6)	0	1500	1	2000	60	590
8.	Const. Speed	33(4)	150	2100	7	2000	90	720
9.	Const. Speed	29	150	1900	7	700	135	730
10.	Const. Speed	26(2)	150	1700	7	2000	65	670
11.	Idle-Accel.	5.5	0	1500	1	2000	60	350
12.	Accel.	50	120	2200	9	700	82	650
13.	Idle	0	0	575	N	2000	90	510
14.	Const. Speed	33	150	2100	7	700	58	640
15.	Decel.	43(8)	160	1750	9	700	116	800
16.	Accel.	50	120	2300	9	700	79	670
17.	Const. Speed	33	150	2100	7	700	119	730
18.	Const. Speed	26	150	1700	7	2000	65	730
19.	Const. Speed	29	150	1900	7	700	139	730
20.	Idle	0	0	575	N	2000	80	610
21.	Decel.	43	160	1750	9	2000	86	830
22.	Idle-Accel.	5.5	0	1500	1	700	104	290
23.	Decel.	43	160	1750	9	700	139	670
24.	Const. Speed	33	150	2100	7	2000	65	730
25.	Accel.	50	120	2200	9	700	112	700
26.	Decel.	43	160	1750	9	2000	86	770
27.	Const. Speed	26	150	1700	7	700	113	730
28	Idle	0	0	640	N	700	122	540

(1) - (8) See Table 12 for explanation.

(9) Temperatures recorded continuously. Steady state runs averaged over the one-minute exposure period. Original and repeat transient runs averaged at time of exposure.

TABLE 15 REPRESENTATIVE TRUCK-TRACTOR EXHAUST AND STACK TEMPERATURES OBTAINED DURING SERIES 12 MIXED CONDITIONS

Run No.	Type Operation	Speed MPH	Load HP	Engine RPM	Gear No.	Dilution Ratio(1)	Representative(9) Temperatures F. Sample	Stack
1.	Accel.	43-53(7)	120	2200	9	2000	58	700
2.	Const. Speed	26(2)	150	1700	7	700	82	800
3.	Idle	0(5)	0	575	N	700	66	480
4.	Const. Speed	26	150	1700	7	2000	76	770
5.	Const. Speed	33(4)	150	2100	7	2000	104	800
6.	Decel.	52-0(8)	160	2100	9	700	158	860
7.	Accel.	43-53	120	2200	9	2000	99	650
8.	Const. Speed	33	150	2100	7	700	110	740
9.	Const. Speed	29(3)	150	1900	7	2000	73	740
10.	Const. Speed	29	150	1900	7	700	140	750
11.	Idle-Accel.	0-8(6)	0	1500	1	700	98	290
12.	Const. Speed	33	150	2100	7	2000	72	740
13.	Accel.	43-53	120	2200	9	700	123	650
14.	Decel.	52-0	160	2100	9	2000	90	830
15.	Idle	0	0	575	N	2000	76	450
16.	Const. Speed	29	150	1900	7	700	134	680
17.	Idle-Accel.	0-8	0	1500	1	700	74	280
18.	Const. Speed	26	150	1700	7	2000	63	680
19.	Decel.	52-0	160	2100	9	700	144	830
20.	Const. Speed	26	150	1700	7	700	127	700
21.	Const. Speed	29	150	1900	7	2000	103	720
22.	Idle	0	0	575	N	700	66	480
23.	Decel.	52-0	160	2100	9	2000	86	830
24.	Idle-Accel.	0-8	0	1500	1	2000	71	190
25.	Const. Speed	33	150	2100	7	700	134	680
26.	Accel.	43-53	120	2200	9	700	144	650
27.	Idle-Accel.	0-8	0	1500	1	2000	71	290
28.	Idle	0	0	575	N	2000	79	520

(1) - (8) See Table 13 for explanation.

(9) Temperatures recorded continuously. Steady state runs averaged over the one-minute exposure period. Original and repeat transient runs averaged at time of exposure.

TABLE 16. INITIAL CONSTANT SPEED SMOKE MEASUREMENT RESULTS (Exploratory)

Vehicle: Truck-Tractor
Transmission: Fuller 10 speed Road Ranger
Inertia: 37,000 lbs. simulated

Engine: Cummins NH 220
Axle: Tandem Spicer 1 speed
Fuel: Reference No. 2

Run No.	Vehicle Speed MPH	Engine Speed RPM	Drive Gear No.	Vehicle Load Hp(1)	P. H. S. Smokemeter Reading %	Hartridge Smokemeter Units
1	27	1700	7	160	22	72
2	33	1700	8	140	15	46
3	42	1700	9	144	20	50
4	52	1700	10	140	20	55

(1) Open rack, maximum power

TABLE 17. PERFORMANCE OF COMMERCIALLY AVAILABLE SMOKE SUPPRESSANT ADDITIVE

Vehicle: Truck-Tractor
Transmission: Fuller 10 Speed Road Ranger
Inertia: 32,000 lbs. simulated

Engine: Cummins NH 220
Axle: Tandem Spicer 1 speed
Fuel: Reference No. 2

Run No.	Vehicle Speed MPH	Engine Speed RPM	Drive Gear No.	Vehicle Load Hp (1)	Type of Smokemeter	Reference Fuel	Additive Fuel (2)	Percent Smoke Change
1	27	1700	7	160	PHS, %	21	9	-57
					Hartridge, units	63	25	-60
2	33	1700	8	140	PHS, %	14	5.5	-61
					Hartridge, units	39	14.5	-63
3	42	1700	9	144	PHS, %	16.5	6.5	-61
					Hartridge, units	46	16	-65
4	52	1700	10	140	PHS, %	20	6	-70
					Hartridge, units	51	17	-67

(1) Open rack, maximum power

(2) Reference No. 2 fuel plus Barium containing DCI additive, 1 gallon DCI per 100 gallons of reference fuel

TABLE 18 CONSTANT SPEED SMOKE MEASUREMENT RESULTS
(Transmission in 7th Gear)

Vehicle: Truck-Tractor
Transmission: Fuller 10 speed Road Ranger
Inertia: 32,000 lbs. simulated

Engine: Cummins NH 220
Axle: Tandem Spicer 1 speed
Fuel: Reference No. 2

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	P. H. S.(2) Smokemeter Reading, %
1.	21	1400	0	1.5
2.	21	1400	20	2.0
3.	21	1400	40	2.5
4.	21	1400	60	2.5
5.	21	1400	80	3.0
6.	21	1400	100	3.5
7.	21	1400	120	5.5
8.	21	1400	140(1)	12.5
1.	23	1500	0	1.5
2.	23	1500	20	2.0
3.	23	1500	40	2.5
4.	23	1500	60	2.5
5.	23	1500	80	3.5
6.	23	1500	100	5.0
7.	23	1500	110	7.0
8.	23	1500	120	8.0
9.	23	1500	140(1)	17.0
1.	25	1700	0	2.0
2.	25	1700	20	2.5
3.	25	1700	40	3.0
4.	25	1700	60	3.5
5.	25	1700	80	4.0
6.	25	1700	100	5.5
7.	25	1700	120	8.0
8.	25	1700	140	11.5
9.	25	1700	150(1)	17.0

TABLE 18 CONSTANT SPEED SMOKE MEASUREMENT RESULTS Page 2

(Transmission in 7th Gear)

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	P. H. S. (2) Smokemeter Reading, %
1.	29	1900	0	1.5
2.	29	1900	20	1.5
3.	29	1900	40	2.0
4.	29	1900	60	2.0
5.	29	1900	80	2.5
6.	29	1900	100	3.5
7.	29	1900	120	5.5
8.	29	1900	140	9.5
9.	29	1900	160	13.0
10.	29	1900	180(1)	16.5
1.	31	2100	0	2.0
2.	31	2100	20	2.0
3.	31	2100	40	2.0
4.	31	2100	60	2.0
5.	31	2100	80	2.5
6.	31	2100	100	3.5
7.	31	2100	120	5.5
8.	31	2100	140	6.5
9.	31	2100	160	11.5
10.	31	2100	180(1)	15.0
1.	35	2300	0	2.5
2.	35	2300	20	3.0
3.	35	2300	40	3.5
4.	35	2300	60(1)	4.0

(1) Open rack, Maximum power
(2) PHS Smokemeter light beam 5-1/2 inches above 4" dia. stack

TABLE 19 CONSTANT SPEED SMOKE MEASUREMENT RESULTS
(Transmission in 8th Gear)

Vehicle: Truck-Tractor
Transmission: Fuller 10 speed Road Ranger
Inertia: 32,000 lbs. simulated

Engine: Cummins NH 220
Axle: Tandem Spicer 1 speed
Fuel: Reference No. 2

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	P. H. S. (2) Smokemeter Reading, %
1.	27	1400	0	2.0
2.	27	1400	20	2.0
3.	27	1400	40	2.5
4.	27	1400	60	3.0
5.	27	1400	80	3.5
6.	27	1400	100	5.0
7.	27	1400	120	12.0
8.	27	1400	130(1)	19.0
1.	29	1500	0	1.5
2.	29	1500	20	1.5
3.	29	1500	40	2.0
4.	29	1500	60	2.0
5.	29	1500	80	3.0
6.	29	1500	100	4.0
7.	29	1500	120	7.0
8.	29	1500	140(1)	18.0
1.	33	1700	0	2.5
2.	33	1700	20	3.0
3.	33	1700	40	3.5
4.	33	1700	60	3.5
5.	33	1700	80	5.0
6.	33	1700	100	7.0
7.	33	1700	120	8.0
8.	33	1700	140	14.5
9.	33	1700	160(1)	16.0

TABLE 19 CONSTANT SPEED SMOKE MEASUREMENT RESULTS Page 2

(Transmission in 8th gear)

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	P. H. S. (2) Smokemeter Reading, %
1.	37	1900	0	3.0
2.	37	1900	20	4.0
3.	37	1900	40	4.0
4.	37	1900	60	4.5
5.	37	1900	80	5.0
6.	37	1900	100	6.0
7.	37	1900	120	7.5
8.	37	1900	140	11.5
9.	37	1900	160(1)	19.5
1.	40	2100	0	2.5
2.	40	2100	20	3.0
3.	40	2100	40	4.0
4.	40	2100	60	4.0
5.	40	2100	80	4.5
6.	40	2100	100	5.5
7.	40	2100	120	7.5
8.	40	2100	140	10.5
9.	40	2100	160	14.5
10.	40	2100	172(1)	18.0
1.	43	2300	0	4.5
2.	43	2300	20	4.0
3.	43	2300	40	4.0
4.	43	2300	60(1)	4.5

(1) Open rack, maximum power

(2) PHS Smokemeter light beam 5-1/2 inches above 4" dia. stack.

TABLE 20 CONSTANT SPEED SMOKE MEASUREMENT RESULTS
(Transmission in 9th Gear)

Vehicle: Truck Tractor
Transmission: Fuller 10 speed Road Ranger
Inertia: 32,000 lbs. simulated
Engine: Cummins NH220
Axle: Tandem Spicer 1 speed
Fuel: Reference No. 2

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	P. H. S. (2) Smokemeter Reading, %
1.	34	1400	0	1.0
2.	34	1400	20	1.0
3.	34	1400	40	1.0
4.	34	1400	60	1.0
5.	34	1400	80	1.5
6.	34	1400	100	1.5
7.	34	1400	120	7.5
8.	34	1400	140(1)	10.0
1.	36	1500	0	1.5
2.	36	1500	20	2.0
3.	36	1500	40	2.0
4.	36	1500	60	2.5
5.	36	1500	80	3.0
6.	36	1500	100	4.5
7.	36	1500	120	7.0
8.	36	1500	130(1)	12.0
1.	41	1700	0	2.5
2.	41	1700	20	3.0
3.	41	1700	40	3.5
4.	41	1700	60	4.0
5.	41	1700	80	5.0
6.	41	1700	100	6.0
7.	41	1700	120	9.5
8.	41	1700	140(1)	16.0

TABLE 20 CONSTANT SPEED SMOKE MEASUREMENT RESULTS Page 2
(Transmission in 9th Gear)

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	P. H. S. (2) Smokemeter Reading, %
1.	46	1900	0	3. 0
2.	46	1900	20	3. 5
3.	46	1900	40	4. 0
4.	46	1900	60	4. 0
5.	46	1900	80	4. 0
6.	46	1900	100	4. 5
7.	46	1900	120	8. 5
8.	46	1900	140	12. 0
9.	46	1900	160(1)	16. 5
1.	51	2100	0	3. 0
2.	51	2100	20	3. 5
3.	51	2100	40	4. 5
4.	51	2100	60	6. 0
5.	51	2100	80	6. 5
6.	51	2100	100	8. 0
7.	51	2100	120	11. 0
8.	51	2100	140	15. 0
9.	51	2100	160(1)	18. 5
1.	53	2200	0	3. 0
2.	53	2200	20	3. 5
3.	53	2200	40	4. 0
4.	53	2200	60	4. 0
5.	53	2200	80	5. 5
6.	53	2200	100	6. 5
7.	53	2200	120	8. 0
8.	53	2200	140(1)	12. 0

(1) Open rack, maximum power
(2) PHS Smokemeter light beam 5-1/2 inches above 4" dia. stack

TABLE 21 CONSTANT SPEED SMOKE MEASUREMENT RESULTS
(Transmission in 10th Gear)

Vehicle: Truck-Tractor
Transmission: Fuller 10 speed Road Ranger
Inertia: 32,000 lbs. simulated

Engine: Cummins NH220
Axle: Tandem Spicer 1 speed
Fuel: Reference No. 2

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	P. H. S.(2) Smokemeter Reading, %
1.	41	1400	0	2.5
2.	41	1400	20	2.5
3.	41	1400	40	2.5
4.	41	1400	60	3.0
5.	41	1400	80	3.5
6.	41	1400	100	6.0
7.	41	1400	110	12.0
8.	41	1400	120(1)	21.0
1.	44	1500	0	1.0
2.	44	1500	20	1.5
3.	44	1500	40	1.5
4.	44	1500	60	1.5
5.	44	1500	80	2.0
6.	44	1500	100	5.0
7.	44	1500	120	11.0
8.	44	1500	130(1)	19.0
1.	50	1700	0	2.0
2.	50	1700	20	2.0
3.	50	1700	40	2.5
4.	50	1700	60	3.0
5.	50	1700	80	3.5
6.	50	1700	100	6.0
7.	50	1700	120	10.0
8.	50	1700	140	18.0
9.	50	1700	150(1)	21.0

TABLE 21 CONSTANT SPEED SMOKE MEASUREMENT RESULTS Page 2
(Transmission in 10 Gear)

Run No.	Vehicle Speed MPH	Engine Speed RPM	Vehicle Load HP	P. H. S. (2) Smokemeter Reading, %
1.	57	1900	0	2. 5
2.	57	1900	20	3. 5
3.	57	1900	40	3. 5
4.	57	1900	60	4. 5
5.	57	1900	80	5. 0
6.	57	1900	100	6. 0
7.	57	1900	120	7. 5
8.	57	1900	140	15. 0
9.	57	1900	160(1)	17. 0
1.	65	2100	0	4. 0
2.	65	2100	20	4. 0
3.	65	2100	40	4. 5
4.	65	2100	60	5. 0
5.	65	2100	80	6. 5
6.	65	2100	100	8. 5
7.	65	2100	120	13. 5
8.	65	2100	140	16. 0
9.	65	2100	160(1)	17. 0
1.	70	2200	0	3. 5
2.	70	2200	20	3. 5
		Discontinued		

(1) Open rack, maximum power

(2) PHS Smokemeter light beam 5-1/2 inches above 4" dia. stack.

TABLE 22 IDLE-ACCELERATION SMOKE MEASUREMENT RESULTS

Vehicle: Truck-Tractor
Transmission: Fuller 10 speed Road Ranger
Inertia: 32,000 lbs. simulated

Engine: Cummins NH220
Axle: Tandem Spicer 1 Speed
Fuel: Reference No. 2

Run No.	Load Impressed at 30 mph, hp	End of Accel. Conditions(2) Drive Gear	Engine RPM	Load HP	Engine Start(4)	PHS Smokemeter Maximum Readings, % 1st Gear	2nd Gear	3rd Gear	4th Gear	5th Gear	6th Gear	7th Gear	8th Gear	9th Gear	10th Gear
1	0	10	2260	0	54	11.0	5.0	5.5	4.5	10	18.5	29.	22.	22.	24.
1A	0	10	2260	0	35	9.0	6.5	7.5	11.0	17.0	19.5	25.0	22.5	25.	26.
Average					45	10.0	5.8	6.5	7.8	13.5	19.0	27.0	22.3	24.	25.
2	10	10	2240	40	45	9.0	7.5	7.5	24.0	22.	22.	25.	21.5	24.	23.5
2A	10	10	2240	40	42	13.0	6.0	19.0	14.5	13.5	12.0	22.5	21.5	23.	23.5
Avezage					44	11.0	6.8	13.3	19.3	17.8	17.0	23.8	21.5	24.	23.5
3	20	10	1750	135	35.5	7.0	6.0	7.5	18.5	17.0	26.0	28.5	21.5	23.5	22.0
3A	20	10	1750	135	51.5	11.0	7.0	15.0	21.5	15.0	23.0	26.0	24.	24.	21.5
Average					43.5	9.0	6.5	11.3	20.0	16.0	24.5	27.3	22.8	23.8	21.8
4	30	8	2245	80(3)	47.0	8.5	7.0	15.0	14.0	23.5	23.	22.	22.	--	--
4A	30	8	2245	80	43.0	9.5	14.0	11.5	22.5	18.5	22.	21.5	23.5	--	--
Average					45.0	9.0	10.5	13.3	18.3	21.0	23.	21.8	22.8	--	--
5	40	7	2275	60(3)	49.	8.0	9.5	8.5	23.5	15.0	27.	21.5	--	--	--
5A	40	7	2275	60	47.	9.5	16.5	10.0	23.5	14.0	17.	20.0	--	--	--
Average					48.	8.8	13.0	9.3	23.5	14.5	22.	20.8	--	--	--
6	50	9	1900	150	37.	8.0	8.0	10.0	10.5	10.0	25.	23.5	24.	22.5	--
6A	50	9	1900	150	34.5	13.5	12.0	19.5	13.0	21.5	20.5	21.5	24.	21.0	--
Average					35.8	10.8	10.0	14.8	11.8	15.8	22.8	22.5	24.	21.8	--
7	60	9	1700	140	57.	16.0	10.5	10.5	11.5	19.5	22.5	22.5	22.5	25.5	--
7A	60	9	1700	140	46.	18.5	10.5	19.0	18.0	18.5	18.5	20.0	22.0	25.0	--
Average					52.	17.3	10.5	14.8	14.8	19.0	20.5	21.3	22.3	25.3	--
8	70	8	2100	160	40.0	9.5	10.5	17.0	11.5	19.5	23.5	22.0	21.5	--	--
8A	70	8	2100	160	35.5	9.0	9.5	9.0	10.5	12.5	23.0	21.5	21.5	--	--
Average					37.8	9.3	10.0	13.0	11.0	16.0	23.3	21.8	21.5	--	--
9	80	8	2050	170	50.5	13.0	8.5	12.0	12.0	23.0	21.0	22.0	--	--	--
9A	80	8	2050	170	34.5	15.0	25.0	10.0	11.5	22.5	20.5	21.5	--	--	--
Average					42.5	14.0	16.8	11.0	11.8	22.8	20.8	21.8	--	--	--

TABLE 22 IDLE-ACCELERATION SMOKE MEASUREMENT RESULTS Page 2

Run No.	Load Impressed at 30 mph, hp	End of Accel. Conditions(2) Drive Gear	Engine RPM	Load HP	PHS Smokemeter Maximum Readings, % Engine Start	1st Gear	2nd Gear	3rd Gear	4th Gear	5th Gear	6th Gear	7th Gear	8th Gear	9th Gear	10th Gear
10	90	8	1900	160	47.5	13.0	10.0	6.0	9.5	16.5	22.0	20.5	22.0	--	--
10A	90	8	1900	160	24.0	9.0	6.5	8.0	15.5	16.0	22.5	19.0	19.0	--	--
Average					35.8	11.0	8.3	7.0	12.5	16.3	22.3	18.8	20.5	--	--
11	100	8	1850	160	41.0	12.5	11.5	10.5	19.0	25.5	22.5	19.5	18.0	--	--
11A	100	8	1850	160	40.5	10.0	6.5	8.5	16.5	19.0	22.0	19.0	18.0	--	--
Average					40.8	11.3	9.0	9.5	17.8	22.3	22.3	19.3	18.0	--	--
12	110	8	1750	160	40.0	10.5	8.0	16.0	13.5	21.0	19.5	20.5	22.0	--	--
12A	110	8	1750	160	36.5	12.5	8.0	14.0	15.0	21.5	21.0	21.0	19.0	--	--
Average					38.3	11.8	8.0	15.0	24.3	21.3	20.3	20.3	20.5	--	--
13	120	7	2200	160	30.5	10.0	8.0	9.5	13.0	16.5	21.0	19.5	--	--	--
13A	120	7	2200	160	30.5	8.0	7.0	8.5	11.0	17.5	21.0	19.5	--	--	--
Average					30.5	9.0	7.5	9.0	12.0	17.0	21.0	19.5	--	--	--
14	130	7	2150	170	48.5	9.0	6.5	10.0	9.5	14.0	20.0	18.5	--	--	--
14A	130	7	2150	170	36.5	10.0	7.0	9.0	12.0	11.5	21.0	19.0	--	--	--
Average					42.5	9.5	6.8	9.5	10.8	22.8	20.5	18.8	--	--	--
15	140	7	2150	170	41.0	9.0	10.0	7.5	8.0	8.0	19.0	19.5	--	--	--
15A	140	7	2150	170	44.0	11.5	7.5	10.0	12.0	16.0	21.0	20.0	--	--	--
Average					42.5	10.3	8.8	8.8	10.0	7.0	20.0	19.3	--	--	--
16	150	6	2250	110	38.0	9.0	5.0	8.5	11.0	16.5	19.0	---	---	--	--
16A	150	6	2250	110	41.0	9.0	5.0	8.0	13.0	12.5	22.5	--	--	--	--
Average					39.5	9.0	5.0	8.3	12.0	19.5	20.8	--	--	--	--
17	160	6	2230	100	46.5	10.5	8.5	8.0	10.0	20.0	18.0	--	--	--	--
17A	160	6	2230	100	43.0	8.0	7.5	5.0	11.5	15.0	18.5	--	--	--	--
Average					44.8	9.3	8.0	6.5	10.8	17.5	18.3	--	--	--	--
18	170	6	2200	120	37.0	8.0	6.0	6.5	8.0	19.0	18.0	--	--	--	--
18A	170	6	2200	120	37.0	7.0	7.5	6.0	8.5	13.0	18.0	--	--	--	--
Average					37.0	7.5	6.8	6.3	8.3	16.0	18.0	--	--	--	--

(1) Load impressed in water brake dynamometer at 30 mph and retained throughout acceleration.
(2) Idle for one minute followed normal acceleration through each of the ten forward speeds.
(3) The last gear operated in was selected on basis of maintaining engine speed as near 2300 rpm as possible.
(4) One black puff.

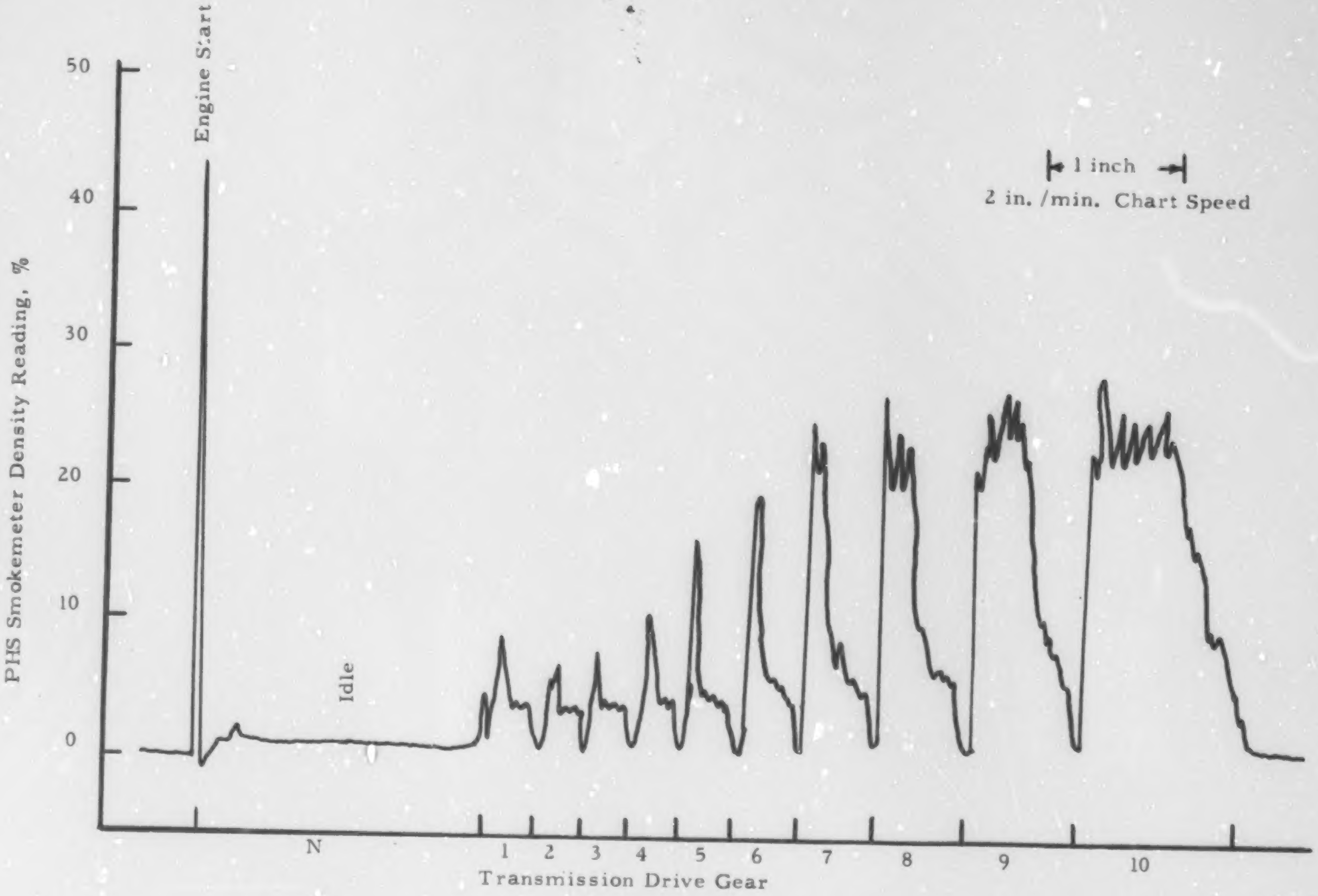


Figure 1. Run 1 A. IDLE-ACCELERATION TRUCK EXHAUST SMOKE
(No Dynamometer Load)

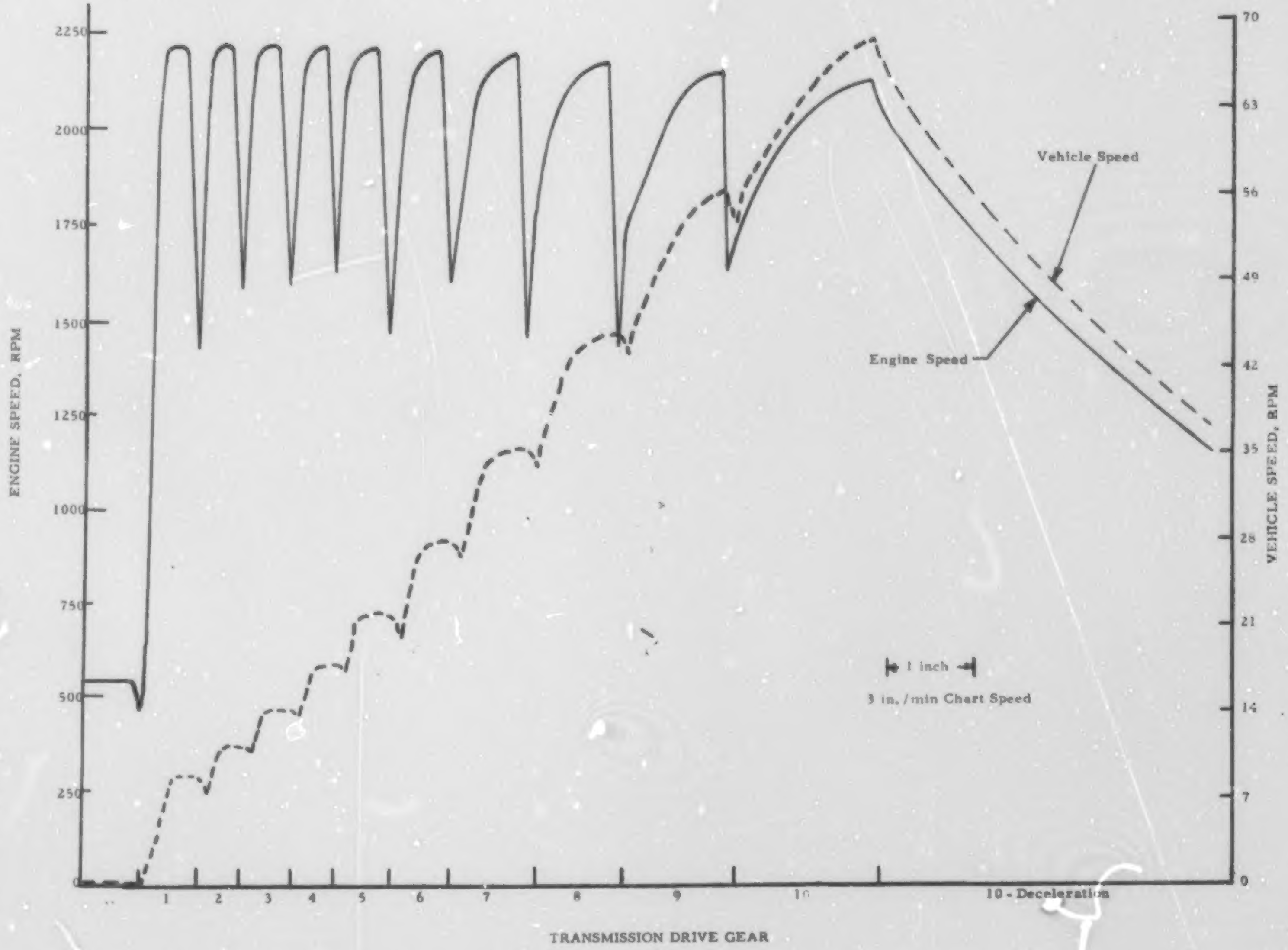


Figure 1A. Run 1A. IDLE-ACCELERATION SMOKE EVALUATION ENGINE AND VEHICLE OPERATING DATA
(No Dynamometer Load)

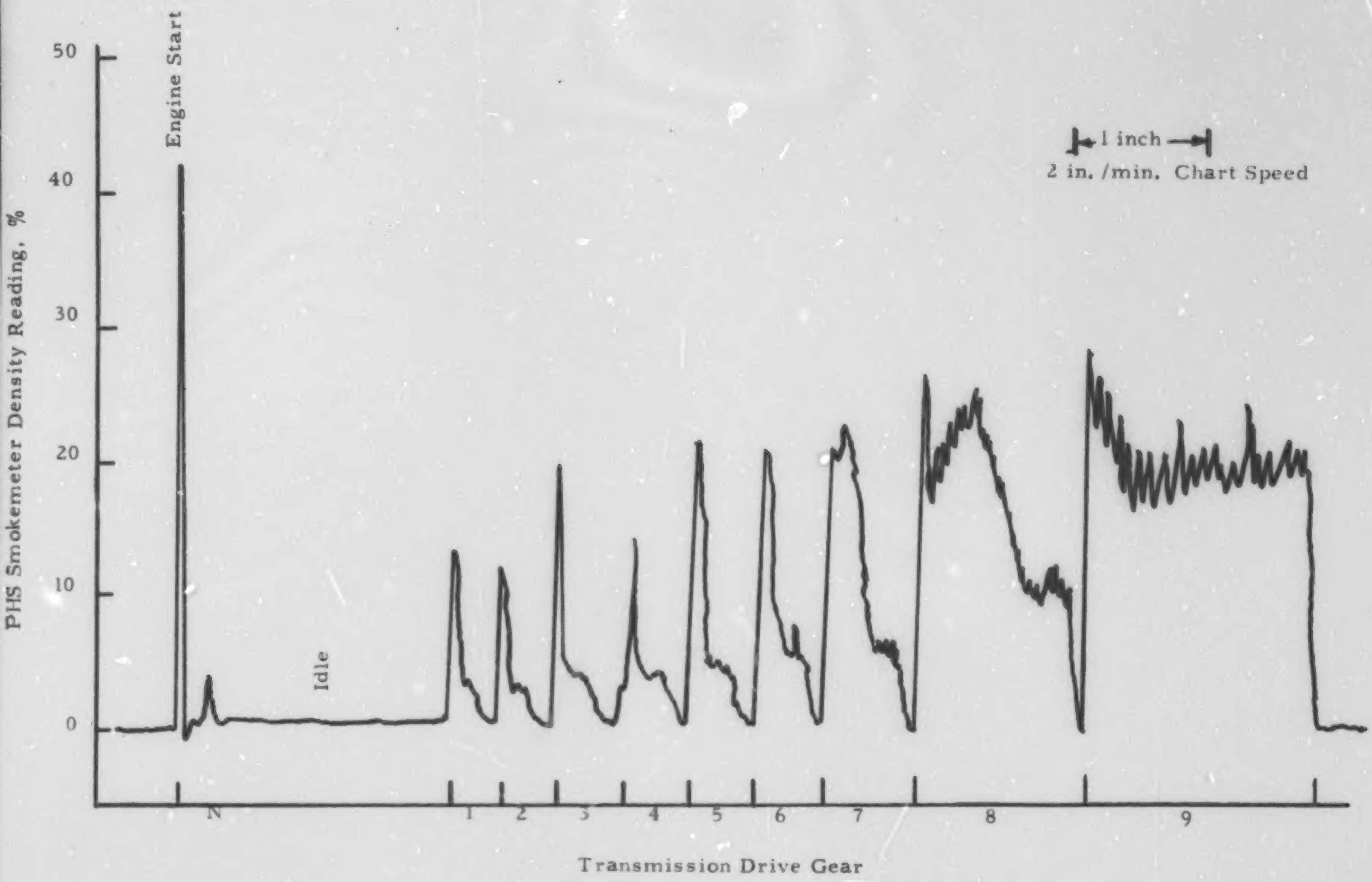


Figure 2. Run 6 IDLE-ACCELERATION TRUCK EXHAUST SMOKE
(50 hp Impressed in Dynamometer at 30 mph)

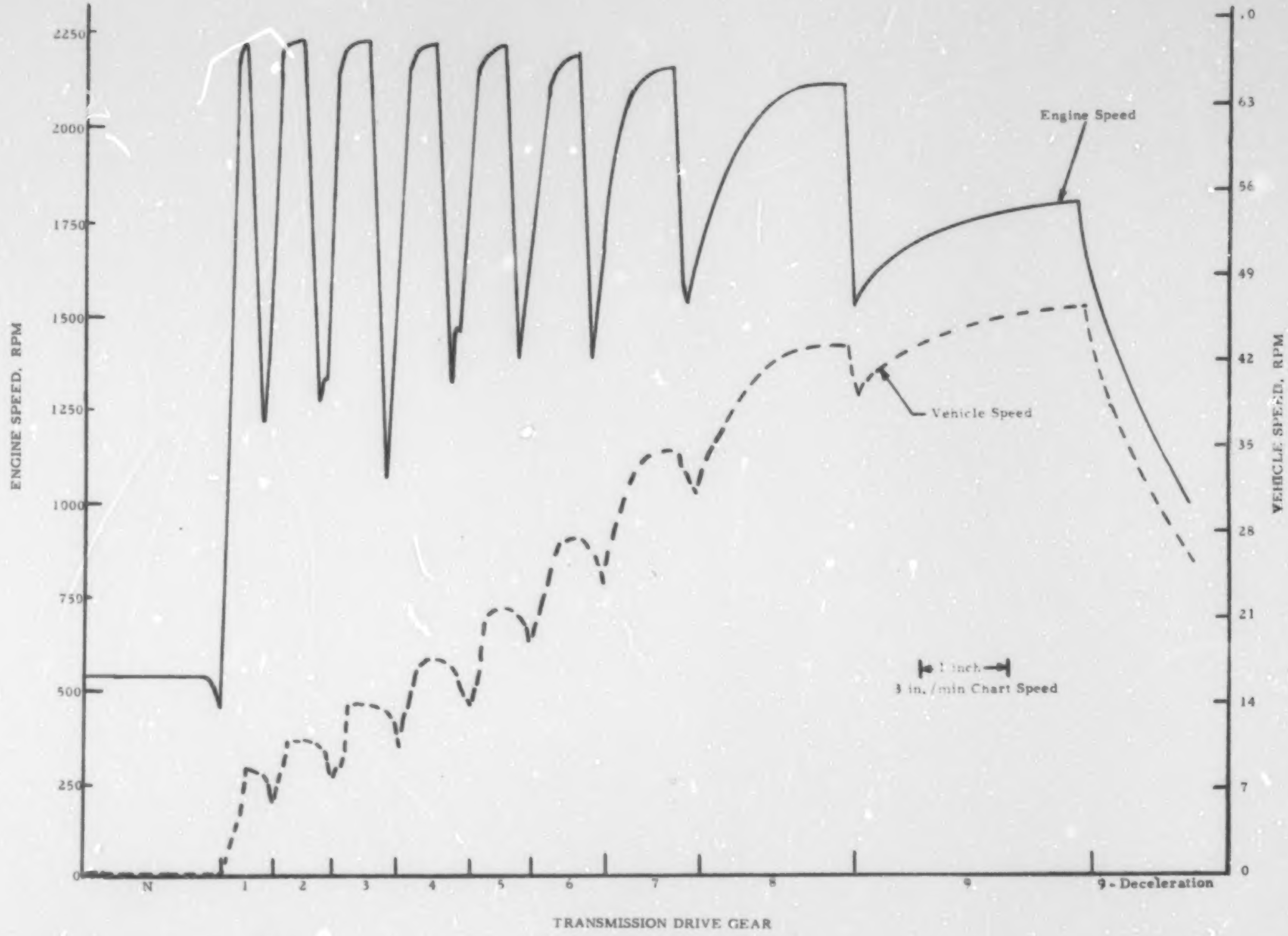


Figure 2A. Run 6. IDLE-ACCELERATION SMOKE EVALUATION ENGINE AND VEHICLE OPERATING DATA
(50 hp Impressed in Dynamometer at 30 mph)

APPENDIX E

CITY BUS VARIABILITY RESULTS
(GM 6V-71, Two-Cycle Engine)

TABLE 1. LIST OF MUNICIPAL BUSES EVALUATED DURING VEHICLE VARIABILITY STUDY

Series No.	Bus No.	Total Engine Miles	For Odor Results See	For Smoke Results See
1.	676	210, 758	Table 7-7E	Table 21
2.	678	216, 022	Table 8-8E	Table 22
3.	677	226, 541	Table 9-9E	Table 23
4.	680	205, 226	Table 10-10E	Table 24
5.	681	223, 084	Table 11-11E	Table 25
6.	682	215, 891	Table 12-12E	Table 26
7.	683	204, 494	Table 13-13E	Table 27
8.	684	245, 161	Table 14-14E	Table 28
9.	685	242, 693	Table 15-15E	Table 29
10.	695	226, 847	Table 16-16E	Table 30

TABLE 2. CITY BUS VEHICLE VARIABILITY ODOR EVALUATION CONDITIONS

Vehicle Data:	GM Truck and Coach Model TDH-4519 city bus powered by 2 cycle Detroit Diesel 6V-71 E Series, 2 valve engine. Muffler under coach.
Sampling Data:	Constant sample flow at 100:1 dilution level.
Inertia:	Full inertia simulation via SwRI system.

OPERATING CONDITIONS

	Type Operation	Vehicle Speed, mph	Vehicle Load, hp	For Details, Refer to:
I.	Constant Speed	20	40	Table 3
II	Constant Speed	40	40	Table 3
III	Constant Speed-Idle	-	-	Table 4
IV	Idle-Acceleration	0-20	0	Table 5
V	Constant Speed-Deceleration	40-0	40 hp @ 40 mph	Table 6

TABLE 3. CONSTANT SPEED DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Variability Study)

Applicability: GM Truck and Coach Model 4519 City Bus powered by Detroit Diesel 6 V-71 engine

Sample Method: Constant Sample flow at 100:1 dilution level.

Warm-up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and system have reached operating temperature.

Vehicle Speeds and Loads: The following are to be run with the transmission in the drive range under full inertia simulation, air conditioning "off".

Vehicle Speed, mph	Engine Speed rpm	Vehicle Load, Hp	Power Level, approx.
20	890	40	Near max
40	1590	40	2/3 rack

Procedure:

(1) Operate at given stable speed and load for 15 seconds

(2) Turn "on" 45 second panel warning light, turn dilution system to "auto" control, and continue stable operation

(3) Ring bell for panel to begin odor evaluation and maintain stable operation

(4) Panel turns "off" light when evaluation is complete. The evaluation requires 50-70 seconds to complete.

(Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with 2 to 3 exposures (sniffs) at will during the approximately 60 second period.

(5) When light goes "off", turn dilution system to "man" control, and decelerate to idle. Permit rear tires to rotate and cool.

(6) Wait 5 minutes between runs for panel rest, tire cooling, and orifice change. (Time starts when light goes "out")

Run Time: Approximately - 3 minutes, with 5 minute rest - 8 minutes.

TABLE 4. ENGINE IDLE DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Variability Study)

Applicability: GM Truck and Coach Model 4519 City Bus powered by Detroit Diesel 6 V-71 engine.

Sample Method: Constant Sample flow at 100:1 dilution level.

Warm-up: A minimum of three complete runs should be conducted prior to odor evaluation to assure the engine and system has reached operating temperature.

Vehicle Speed and Load: Operate at 30 mph and 40 hp for one minute followed by closed rack deceleration to downshift (17 mph) and allow engine to idle. (Air conditioning off and with inertia simulation.)

Procedure:

(1) Operate at 30 mph and 40 hp, stable.

(2) Turn "on" panel warning light and maintain stable operation.

(3) After one minute of stable sustained operation, closed rack deceleration to downshift and allow engine to idle.

(4) Turn dilution system to "auto." 2 seconds after downshift.

(5) Ring bell to begin panel exposure 15 seconds after downshift.

(6) Panel turns "off" light when evaluation is complete. The evaluation requires 50-70 seconds to complete. (Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with 2 to 3 exposures (sniffs) at will during the approximately 60 second period.

(7) When light is "off", turn dilution system to "man" control and permit rear tires to rotate and cool.

(8) Wait 5 minutes between runs for panel rest, tire cooling, and orifice change. (Time starts when light goes "out".)

Run Time: Approximately - 3 minutes with 5 minute rest - 8 minutes.

TABLE 5. IDLE-ACCELERATION DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Variability Study)

Applicability: GM Truck and Coach Model 4519 City Bus powered by Detroit Diesel 6V-71 engine.

Sample Method: Constant sample flow at 100:1 dilution level.

Warm-Up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and system have reached operating temperature.

Inertia: Full inertia simulation via SwRI system.

Vehicle Speed and Load: Idle for 1 minute followed by full rack acceleration to 20 mph with inertia only.

Procedure:

(1) Turn "on" 60 second panel warning light, turn dilution system to "auto" and idle for 1 minute, rear wheels stationary.

(2) Accelerate full rack to 20 mph under full inertia simulation.

(3) Ring bell for panel exposure 3 seconds after start of acceleration.

(4) Hold 20 mph for 15 seconds, turn off engine and turn dilution system to "man".

(5) Two minutes after turning "off" engine, start engine and allow to idle. Turn on 60-second panel warning light and turn dilution system to "auto". Allow to idle for 1 minute, rear wheels stationary.

(6) Repeat items (2) through (5) above. The original and repeat idle-acceleration constitute one run.

(7) Wait 5 minutes between runs for panel rest, tire cooling, and orifice change. (Time starts when engine is turned "off".

Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite, and each of the four qualities with an original and a repeat exposure (sniff).

Run Time: Approximately - 6.5 minutes
With 5 minute rest - 11.5 minutes.

TABLE 6.. CONSTANT SPEED-DECELERATION DIESEL ODOR QUALITY/ INTENSITY EVALUATION PROCEDURE

(Variability Study)

Applicability: GM Truck and Coach Model 4519 City Bus Powered by Detroit Diesel 6V-71 engine

Sample Method: Constant sample flow at 100:1 dilution level.

Warm-up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and system have reached operating temperature.

Inertia: Full inertia simulation via SwRI system.

Vehicle Speed and Load: Operate at stable 40 mph and 40 hp for 1 minute followed by closed rack deceleration with full inertia simulation, air conditioning "off"

Procedure:

(1) Operate at 40 mph and 40 hp, stable.

(2) Turn "on" 60 second panel warning light, turn dilution system to "auto" and maintain stable operation.

(3) After one minute of stable sustained operation, closed rack deceleration to downshift.

(4) Ring bell for panel exposure at 23 mph.

(5) On reaching downshift (17 mph), permit engine to idle and cool tires. Turn "off" light and turn dilution system to "man".

(6) Two minutes after downshift, return to 40 mph and 40 hp condition.

(7) Repeat items (2) through (5) above. The original and repeat constant speed - deceleration constitute one run.

(8) Wait 5 minutes between runs for panel rest, tire cooling, and orifice change. (Time starts on engine downshift).

Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with only an original and a repeat exposure (sniff).

Run Time: Approximately - 7 minutes
with 5 minute rest - 12 minutes

TABLE 7. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Bus 676
January 3, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 1.	Const. Speed	6.9	2.6	2.2	1.3	0.9
6.	" "	7.2	2.4	1.9	1.6	1.1
18.	" "	7.2	2.4	2.1	1.4	1.2
21.	" "	7.2	2.4	2.1	1.8	1.1
		7.1	2.5	2.1	1.5	1.1
II. 8.	Const. Speed	6.8	2.0	2.0	1.0	1.0
13.	" "	7.4	2.6	2.1	1.8	1.4
16.	" "	7.0	2.5	2.2	1.5	1.3
22.	" "	7.2	2.1	2.0	1.4	1.2
		7.1	2.3	2.1	1.4	1.2
III. 2.	Idle	7.7	2.7	2.3	1.4	1.3
9.	"	7.8	2.5	2.1	2.0	1.9
17.	"	7.5	2.5	1.6	1.6	1.3
23.	"	7.6	2.6	2.0	1.6	1.3
		7.7	2.6	2.0	1.7	1.5
IV. 7.	Idle-Accel	6.0	2.0	2.2	1.4	1.0
14.	" "	8.0	2.8	2.4	1.9	1.4
19.	" "	8.0	2.8	2.5	1.8	1.8
24.	" "	7.2	2.0	2.4	1.7	1.4
		7.3	2.4	2.4	1.7	1.4
V. 4.	Decel	7.6	2.9	2.3	1.9	1.2
11.	"	7.2	3.0	2.5	2.0	1.7
20.	"	8.5	2.8	2.2	2.4	1.6
25.	"	7.8	2.9	2.3	2.0	1.5
		7.8	2.9	2.3	2.1	1.5

(1) Runs 3, 5, 10, 12, and 15 were conducted without exhaust sample.

TABLE 7 A. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Composite Standard)

Vehicle: Bus 676
Date: January 3, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"D" Composite Responses 0	1	2	3	4	5	6	7	8	9	Average
1.	Const. Speed							2	7	1		6.9
2.	Idle							1	1	8		7.7
3.	Blank	2	1	2	5							2.0
4.	Decel							1	2	7		7.6
5.	Blank		1	4	4		1					2.6
6.	Const. Speed							1	6	3		7.2
7.	Idle-Accel							1	8	1		6.0
8.	Const. Speed							2	8			6.8
9.	Idle								2	8		7.8
10.	Blank	4	6									0.6
11.	Decel								1	6	3	7.2
12.	Blank	2	3	2	3							1.6
13.	Const. Speed							1	4	5		7.4
14.	Idle-Accel								2	6	2	8.0
15.	Blank	4	2		3	1						1.5
16.	Const. Speed							3	4	3		7.0
17.	Idle							3	1	4	2	7.5
18.	Const. Speed							2	4	4		7.2
19.	Idle-Accel								3	4	3	8.0
20.	Decel								1	3	6	8.5
21.	Const. Speed							1	6	3		7.2
22.	Const. Speed							1	6	3		7.2
23.	Idle							1	2	7		7.6
24.	Idle-Accel							1	6	3		7.2
25.	Decel								2	8		7.8

(1) Runs 3, 5, 10, 12, and 15 were conducted without exhaust sample.

TABLE 7B. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Bus 676
Date: January 3, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"B" Burnt Responses					
No. (1)	Condition	0	1	2	3	4	Average
1.	Const. Speed			4	6		2.6
2.	Idle			3	7		2.7
3.	Blank	3	7				0.7
4.	Decel			1	9		2.9
5.	Blank	3	6	1			0.8
6.	Const. Speed			6	4		2.4
7.	Idle-Accel			7	3		2.0
8.	Const. Speed			7	3		2.0
9.	Idle			5	5		2.5
10.	Blank	9	1				0.1
11.	Decel				10		3.0
12.	Blank	6	4				0.4
13.	Const. Speed			4	6		2.6
14.	Idle-Accel			2	8		2.8
15.	Blank	7		3			0.6
16.	Const. Speed			5	5		2.5
17.	Idle			5	5		2.5
18.	Const. Speed			6	4		2.4
19.	Idle-Accel			2	8		2.8
20.	Decel			3	6	1	2.8
21.	Const. Speed			6	4		2.4
22.	Const. Speed		2	5	3		2.1
23.	Idle			4	6		2.6
24.	Idle-Accel			10			2.0
25.	Decel			1	9		2.9

(1) Runs 3, 5, 10, 12, and 15 were conducted without exhaust sample.

TABLE 7C. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Bus 676
Date: January 3, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"O" Oily Responses					
		0	1	2	3	4	Average
1.	Const. Speed			8	2		2.2
2.	Idle			7	3		2.3
3.	Blank	4	6				0.6
4.	Decel			7	3		2.3
5.	Blank	3	7				0.7
6.	Const. Speed		1	9			1.9
7.	Idle-Accel			8	2		2.2
8.	Const. Speed		2	6	2		2.0
9.	Idle		1	7	2		2.1
10.	Blank	9	1				0.1
11.	Decel			5	5		2.5
12.	Blank	6	3	1			0.5
13.	Const. Speed		2	5	3		2.1
14.	Idle-Accel		1	4	5		2.4
15.	Blank	7	2	1			0.4
16.	Const. Speed		2	4	4		2.2
17.	Idle	1	5	1	3		1.6
18.	Const. Speed		3	3	4		2.1
19.	Idle-Accel		1	3	6		2.5
20.	Decel	1	1	4	3	1	2.2
21.	Const. Speed		2	5	3		2.1
22.	Const. Speed			10			2.0
23.	Idle			10			2.0
24.	Idle-Accel		1	4	5		2.4
25.	Decel			7	3		2.3

(1) Runs 3, 5, 10, 12, and 15 were conducted without exhaust sample.

TABLE 7D. SERIES 1VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 676	Operating Conditions: See Table 2
Date: January 3, 1967	Fuel: Reference No. 1

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	3	Average
1.	Const. Speed	2	4	3	1	1.3
2.	Idle	2	3	4	1	1.4
3.	Blank	9	1			0.1
4.	Decel		2	7	1	1.9
5.	Blank	6	4			0.4
6.	Const. Speed		4	6		1.6
7.	Idle-Accel		6	4		1.4
8.	Const. Speed	2	6	2		1.0
9.	Idle		2	6	2	2.0
10.	Blank	10				.0
11.	Decel		2	6	2	2.0
12.	Blank	9	1			0.1
13.	Const. Speed		3	6	1	1.8
14.	Idle-Accel		3	5	2	1.9
15.	Blank	10				.0
16.	Const. Speed		5	5		1.5
17.	Idle	1	4	3	2	1.6
18.	Const. Speed	1	4	5		1.4
19.	Idle-Accel		2	8		1.8
20.	Decel			6	4	2.4
21.	Const. Speed		3	6	1	1.8
22.	Const. Speed		6	4		1.4
23.	Idle		4	6		1.6
24.	Idle-Accel		4	5	1	1.7
25.	Decel			10		2.0

(1) Runs 3, 5, 10, 12, and 15 were conducted without exhuast sample.

TABLE 7E. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Bus 676
Date: January 3, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"P" Pungent Responses				
		0	1	2	3	Average
1.	Const. Speed	1	9			0.9
2.	Idle	1	5	4		1.3
3.	Blank	9	1			0.1
4.	Decel		8	2		1.2
5.	Blank	9	1			0.1
6.	Const. Speed		9	1		1.1
7.	Idle-Accel	1	8	1		1.0
8.	Const. Speed	2	6	2		1.0
9	Idle		3	5	2	1.9
10.	Blank	10				.0
11.	Decel		4	5	1	1.7
12.	Blank	9	1			0.1
13.	Const. Speed	1	4	5		1.4
14.	Idle-Accel	1	4	5		1.4
15.	Blank	9	1			0.1
16.	Const. Speed		7	3		1.3
17.	Idle	2	3	5		1.3
18.	Const. Speed	1	6	3		1.2
19.	Idle-Accel		2	8		1.8
20.	Decel		4	6		1.6
21.	Const. Speed	1	7	2		1.1
22.	Const. Speed		8	2		1.2
23.	Idle	1	5	4		1.3
24.	Idle-Accel	1	4	5		1.4
25.	Decel		5	5		1.5

(1) Runs 3, 5, 10, 12, and 15 were conducted without exhaust sample.

TABLE 8. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Bus 678
Date: January 4, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	Average Panel Responses "D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 8.	Const. Speed	6.8	2.2	1.9	1.0	1.3
11.	" "	6.3	2.0	1.9	1.3	1.0
20.	" "	6.2	2.1	1.8	1.4	0.6
24.	" "	7.0	2.4	1.9	1.5	1.1
		6.6	2.2	1.9	1.3	1.0
II. 1.	Const. Speed	6.9	2.0	2.2	1.2	1.0
5.	" "	6.7	2.3	2.1	1.5	1.2
17.	" "	8.7	3.0	2.8	2.0	2.3
21.	" "	6.4	2.1	1.9	1.6	0.8
		7.2	2.4	2.3	1.8	1.3
III. 6.	Idle	6.7	2.5	1.9	1.8	1.4
14.	"	7.3	2.7	1.9	2.0	1.7
16.	"	7.2	2.8	2.0	1.9	1.8
25.	"	7.1	2.7	1.9	1.9	1.6
		7.1	2.7	1.9	1.9	1.6
IV. 2.	Idle-Accel	7.3	2.7	2.2	1.9	1.6
9.	" "	8.5	3.1	2.7	2.2	2.0
19.	" "	8.1	2.9	2.6	2.1	1.7
22.	" "	8.6	3.1	2.8	2.1	2.2
		8.1	3.0	2.6	2.1	1.9
V. 4.	Decel	8.1	2.9	2.5	2.3	1.8
10.	"	7.8	2.8	2.2	1.9	1.9
13.	"	7.1	2.7	2.3	1.9	1.4
23.	"	7.7	2.7	2.2	2.0	2.2
		7.7	2.8	2.3	2.1	1.8

(1) Runs 3, 7, 12, 15, and 18 were conducted without exhaust sample.

TABLE 8A. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Composite Standard)

Vehicle: Bus 678
Date: January 4, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"D" Composite Responses								Average
		0	2	5	6	7	8	8.5	9	
1.	Const. Speed				1	9				6.9
2.	Idle-Accel				3	1	6			7.3
3.	Blank	9	1							0.2
4.	Decel					2	5		3	8.1
5.	Const. Speed				3	7				6.7
6.	Idle				6	1	3			6.7
7.	Blank	10								0
8.	Const. Speed				4	4	2			6.8
9.	Idle-Accel						5	1	4	8.5
10.	Decel				1	2	5		2	7.8
11.	Const. Speed				7	3				6.3
12.	Blank	10								0
13.	Decel				1	7	2			7.1
14.	Idle			1	3		4	1	1	7.3
15.	Blank	10								0
16.	Idle				1	6	3			7.2
17.	Const. Speed						3		7	8.7
18.	Blank	9	1							0.2
19.	Idle-Accel				1		6		3	8.1
20.	Const. Speed				8	2				6.2
21.	Const. Speed			2	3	4	1			6.4
22.	Idle-Accel						4		6	8.6
23.	Decel				1	3	4		2	7.7
24.	Const. Speed					10				7.0
25.	Idle				1	7	2			7.1

(1) Runs 3, 7, 12, 15 and 18 were conducted without exhaust sample.

TABLE 8B. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Bus 678
Date: January 4, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	3	4	Average
1.	Const. Speed			10			2.0
2.	Idle-Accel			3	7		2.7
3.	Blank	10					.0
4.	Decel			1	9		2.9
5.	Const. Speed			7	3		2.3
6.	Idle			5	5		2.5
7.	Blank	10					.0
8.	Const. Speed			8	2		2.2
9.	Idle-Accel				9	1	3.1
10.	Decel			4	4	2	2.8
11.	Const. Speed		1	8	1		2.0
12.	Blank	10					.0
13.	Decel			3	7		2.7
14.	Idle			4	5	1	2.7
15.	Blank	10					.0
16.	Idle			2	8		2.8
17.	Const. Speed				6	4	3.0
18.	Blank	10					.0
19.	Idle-Accel			2	7	1	2.9
20.	Const. Speed			9	1		2.1
21.	Const. Speed		3	3	4		2.1
22.	Idle-Accel			1	7	2	3.1
23.	Decel			4	5	1	2.7
24.	Const. Speed			6	4		2.4
25.	Idle			3	7		2.7

(1) Runs 3, 7, 12, 15, and 18 were conducted without exhaust sample.

TABLE 8C. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Bus 678
Date: January 4, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	3	4	Average
1.	Const. Speed		2	5	3		2.2
2.	Idle-Accel		2	4	4		2.2
3.	Blank	10					.0
4.	Decel			5	5		2.5
5.	Const. Speed			9	1		2.1
6.	Idle		2	7	1		1.9
7.	Blank	10					.0
8.	Const. Speed		2	7	1		1.9
9.	Idle-Accel			3	7		2.7
10.	Decel		1	7	1	1	2.2
11.	Const. Speed		1	9			1.9
12.	Blank	10					.0
13.	Decel			7	3		2.3
14.	Idle		3	5	2		1.9
15.	Blank	10					.0
16.	Idle		1	8	1		2.0
17.	Const. Speed			3	6	1	2.8
18.	Blank	10					.0
19.	Idle-Accel			5	4	1	2.6
20.	Const. Speed		3	6	1		1.8
21.	Const. Speed		3	5	2		1.9
22.	Idle-Accel		1	1	7	1	2.8
23.	Decel		2	5	3		2.2
24.	Const. Speed		2	7	1		1.9
25.	Idle		3	5	2		1.9

(1) Runs, 3, 7, 12, 15, and 18 were conducted without exhaust sample.

TABLE 8D. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 678
Date: January 4, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"A" Aromatic Responses					
		0	1	2	3	4	Average
1.	Const. Speed	2	5	2	1		1.2
2.	Idle-Accel		2	7	1		1.9
3.	Blank	10					.0
4.	Decel		1	5	4		2.3
5.	Const. Speed		6	3	1		1.5
6.	Idle		6	1	2	1	1.8
7.	Blank	10					.0
8.	Const. Speed	2	6	2			1.0
9.	Idle-Accel			8	2		2.2
10.	Decel		3	5	2		1.9
11.	Const. Speed	1	5	4			1.3
12.	Blank	10					.0
13.	Decel		3	5	2		1.9
14.	Idle		2	6	2		2.0
15.	Blank	10					.0
16.	Idle		2	7	1		1.9
17.	Const. Speed		1	8	1		2.0
18.	Blank	10					.0
19.	Idle-Accel		2	5	3		2.1
20.	Const. Speed		6	4			1.4
21.	Const. Speed		4	6			1.6
22.	Idle-Accel			9	1		2.1
23.	Decel		2	6	2		2.0
24.	Const. Speed		5	5			1.5
25.	Idle		3	5	2		1.9

(1) Runs 3, 7, 12, 15, and 18 were conducted without exhaust sample.

TABLE 8E. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Bus 678
Date: January 4, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"P" Pungent Responses				
No. (1)	Condition	0	1	2	3	Average
1.	Const. Speed	1	8	1		1.0
2.	Idle-Accel		4	6		1.6
3.	Blank	10				0
4.	Decel	1	3	3	3	1.8
5.	Const. Speed	2	4	4		1.2
6.	Idle	1	5	3	1	1.4
7.	Blank	10				0
8.	Const. Speed	1	5	4		1.3
9.	Idle-Accel	1	3	4	5	2.0
10.	Decel	1	1	6	2	1.9
11.	Const. Speed	2	6	2		1.0
12.	Blank	10				0
13.	Decel		7	2	1	1.4
14.	Idle	1	4	2	3	1.7
15.	Blank	10				0
16.	Idle		3	6	1	1.8
17.	Const. Speed		2	3	5	2.3
18.	Blank	10				0
19.	Idle-Accel		4	5	1	1.7
20.	Const. Speed	5	4	1		0.6
21.	Const. Speed	3	6	1		0.8
22.	Idle-Accel		2	4	4	2.2
23.	Decel	2		2	6	2.2
24.	Const. Speed	1	7	2		1.1
25.	Idle		4	6		1.6

(1) Runs 3, 7, 12, 15 and 18 were conducted without exhaust sample.

TABLE 9. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Bus 677
Date: January 5, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 4.	Const. Speed	6.2	1.0	1.7	1.4	0.9
7.	" "	6.2	2.0	1.8	1.5	0.7
16.	" "	7.2	2.4	2.2	1.6	1.1
24.	" "	6.6	2.2	2.0	1.5	1.3
		6.6	2.0	1.9	1.5	1.0
II. 1.	Const. Speed	7.2	2.3	2.2	1.3	1.1
12.	" "	6.7	2.0	1.8	1.7	1.3
20.	" "	8.4	3.0	2.9	2.2	1.7
22.	" "	8.7	3.0	2.7	2.8	2.1
		7.8	2.6	2.4	2.0	1.6
III. 14.	Idle	8.3	3.0	2.7	2.1	1.5
15.	"	7.0	2.4	2.0	1.6	1.1
17.	"	7.2	2.3	1.8	1.5	1.3
21.	"	6.8	2.0	1.6	1.8	1.4
		7.3	2.4	2.0	1.8	1.3
IV. 3.	Idle - Accel.	8.8	2.9	2.5	1.9	2.1
6.	" "	8.8	2.9	2.7	2.1	2.1
10.	" "	8.2	3.0	2.6	1.9	2.0
23.	" "	7.9	2.6	2.3	2.2	1.8
		8.4	2.9	2.5	2.0	2.0
V. 2.	Decel.	7.5	2.6	1.9	1.5	1.6
8.	"	7.3	2.4	2.1	1.8	1.6
11.	"	7.1	2.4	2.0	1.9	1.4
18.	"	7.9	2.8	2.7	1.8	1.7
25.	"	6.5	2.1	1.8	1.6	1.2
		7.5	2.5	2.1	1.7	1.5

(1) Runs 5, 9, 13, and 19 were conducted without exhaust sample.

TABLE 9 A. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Composite Standard)

Vehicle: Bus 677
Date: January 5, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"D" Composite Responses											
No. (1)	Condition	0	1	2	3	4	5	6	7	8	9	10	Average
1.	Const. Speed							2	4	4			7.2
2.	Decel						1	1	2	4	2		7.5
3.	Idle-Accel								1	1	7	1	8.8
4.	Const. Speed							8	2				6.2
5.	Blank	7		3									0.6
6.	Idle-Accel								1	1	7	1	8.8
7.	Const. Speed							8	2				6.2
8.	Decel							2	3	5			7.3
9.	Blank	7	1	2									0.5
10.	Idle-Accel								1	6	3		8.2
11.	Decel						1	1	4	4			7.1
12	Const. Speed							3	7				6.7
13.	Blank	10											0
14.	Idle								1	5	4		8.3
15.	Idle							4	2	4			7.0
16.	Const. Speed							2	5	2	1		7.2
17.	Idle						2		4	2	2		7.2
18.	Decel								1	9			7.9
19.	Blank	5	1	2	2								1.1
20.	Const. Speed								1	4	5		8.4
21.	Idle						2	1	5	1	1		6.8
22.	Const. Speed									3	7		8.7
23.	Idle-Accel								3	6		1	7.9
24.	Const. Speed							4	6				6.6
25.	Decel							6	3	1			6.5

(1) Runs 5, 9, 13 and 19 were conducted without exhaust sample

TABLE 9B. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Bus 677
Date: January 5, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	3	Average
1.	Const. Speed			7	3	2.3
2.	Decel			4	6	2.6
3.	Idle-Accel			1	9	2.9
4.	Const. Speed			9	1	2.1
5.	Blank	7	3			0.3
6.	Idle-Accel			1	9	2.9
7.	Const. Speed		1	8	1	2.0
8.	Decel			6	4	2.4
9.	Blank	8	2			0.2
10.	Idle-Accel				10	3.0
11.	Decel		1	4	5	2.4
12.	Const. Speed			10		2.0
13.	Blank	10				0
14.	Idle				10	3.0
15.	Idle			6	4	2.4
16.	Const. Speed			6	4	2.4
17.	Idle		2	3	5	2.3
18.	Decel			2	8	2.8
19.	Blank	6	4			0.4
20.	Const. Speed				10	3.0
21.	Idle		2	6	2	2.0
22.	Const. Speed				10	3.0
23.	Idle-Accel		2		8	2.6
24.	Const. Speed			8	2	2.2
25.	Decel			9	1	2.1

(1) Runs 5, 9, 13, and 19 were conducted without exhaust sample.

TABLE 9C. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Bus 677
Date: January 5, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"O" Oily Responses					
		0	1	2	3	4	Average
1.	Const. Speed		1	6	3		2.2
2.	Decel		3	5	2		1.9
3.	Idle-Accel			5	5		2.5
4.	Const. Speed		4	5	1		1.7
5.	Blank	9	1				0.1
6.	Idle-Accel			4	5	1	2.7
7.	Const. Speed	1	2	8			1.8
8.	Decel		2	5	3		2.1
9.	Blank	8	2				0.2
10.	Idle-Accel			4	6		2.6
11.	Decel		2	6	2		2.0
12.	Const. Speed		3	6	1		1.8
13.	Blank	10					0
14.	Idle			4	5	1	2.7
15.	Idle		3	4	3		2.0
16.	Const. Speed		1	6	3		2.2
17.	Idle		4	4	2		1.8
18.	Decel			3	7		2.7
19.	Blank	8	2				0.2
20.	Const. Speed			2	7	1	2.9
21.	Idle		5	4	1		1.6
22.	Const. Speed			3	7		2.7
23.	Idle-Accel			7	3		2.3
24.	Const. Speed		1	8	1		2.0
25.	Decel		3	6	1		1.8

(1) Runs 5, 9, 13, and 19 were conducted without exhaust sample.

TABLE 9D. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 677
Date: January 5, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	3	Average
1.	Const. Speed	1	5	4		1.3
2.	Decel		5	5		1.5
3.	Idle-Accel		2	7	1	1.9
4.	Const. Speed	1	4	5		1.4
5.	Blank	10				0
6.	Idle-Accel		1	7	2	2.1
7.	Const. Speed		5	5		1.5
8.	Decel		2	8		1.8
9.	Blank	10				0
10.	Idle-Accel		3	5	2	1.9
11.	Decel		3	5	2	1.9
12.	Const. Speed		4	5	1	1.7
13.	Blank	10				0
14.	Idle		2	5	3	2.1
15.	Idle		5	4	1	1.6
16.	Const. Speed		5	4	1	1.6
17.	Idle		6	3	1	1.5
18.	Decel		3	6	1	1.8
19.	Blank	10				0
20.	Const. Speed		1	6	3	2.2
21.	Idle		5	2	3	1.8
22.	Const. Speed		1	7	2	2.8
23.	Idle-Accel			8	2	2.2
24.	Const. Speed	1	4	4	1	1.5
25.	Decel		4	6		1.6

(1) Runs 5, 9, 13, and 19 were conducted without exhaust sample.

TABLE 9E. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Bus 677
Date: January 5, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	2	3	Average
1.	Const. Speed	2	5	3		1.1
2.	Decel	3		5	2	1.6
3.	Idle-Accel		3	3	4	2.1
4.	Const. Speed	2	7	1		0.9
5.	Blank	10				0
6.	Idle-Accel	1	1	4	4	2.1
7.	Const. Speed	4	5	1		0.7
8.	Decel	1	4	3	2	1.6
9.	Blank	10				0
10.	Idle-Accel		2	6	2	2.0
11.	Decel	1	5	3	1	1.4
12.	Const. Speed	2	4	3	1	1.3
13.	Blank	10				0
14.	Idle	1	3	6		1.5
15.	Idle	3	3	4		1.1
16.	Const. Speed	3	3	4		1.1
17.	Idle	2	4	3	1	1.3
18.	Decel		4	5	1	1.7
19.	Blank	10				0
20.	Const. Speed		4	5	1	1.7
21.	Idle	2	3	4	1	1.4
22.	Const. Speed		3	3	4	2.1
23.	Idle-Accel	1		9		1.8
24.	Const. Speed	1	5	4		1.3
25.	Decel	1	6	3		1.2

(1) Runs 5, 9, 13, and 19 were conducted without exhaust sample.

TABLE 10. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: But 680
Date: January 6, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	Average Panel Responses "D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 3.	Const. Speed	6.4	2.3	1.9	1.4	1.1
7.	" "	6.1	2.1	1.6	1.2	0.8
13.	" "	5.8	2.2	1.6	2.1	0.9
19.	" "	6.0	2.0	1.9	1.5	1.1
		6.1	2.2	1.8	1.6	1.0
II. 2.	Const. Speed	6.1	2.1	1.7	1.5	1.1
11.	" "	6.3	2.0	1.9	1.5	0.8
16.	" "	6.2	1.8	2.0	1.8	1.0
23.	" "	7.5	2.7	2.4	1.9	1.2
		6.5	2.2	2.0	1.7	1.1
III. 6.	Idle	6.3	2.1	1.7	1.4	1.3
8.	"	6.5	2.0	1.5	1.4	1.9
20.	"	7.1	2.4	2.2	2.0	1.8
25.	"	6.4	2.3	1.9	1.3	1.2
		6.6	2.2	1.8	1.5	1.6
IV. 4.	Idle - Accel.	7.7	2.5	2.3	1.9	1.4
12.	" "	9.5	2.9	2.8	2.2	1.5
17.	" "	8.3	2.9	2.9	2.1	1.7
24.	" "	8.5	2.9	2.8	2.0	1.8
		8.5	2.8	2.7	2.1	1.6
V. 1.	Decel.	7.1	2.6	2.3	2.1	1.7
9.	"	7.8	2.9	2.5	2.3	2.0
14.	"	5.2	2.8	2.7	2.2	2.1
22.	"	8.9	3.0	3.0	2.0	2.3
		7.3	2.8	2.6	2.2	2.1

(1) Runs 5, 10, 15, 18, and 21 were conducted without exhaust sample.

TABLE 10 A. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Composite Standard)

Vehicle: Bus 680
Date: January 6, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"D" Composite Responses 0	1	2	3	4	5	6	7	8	9	10	Average
1	Decel							1	7	2			7.1
2.	Const. Speed							9	1				6.1
3.	Const. Speed							6	4				6.4
4.	Idle-Accel						1	2		3	4		7.7
5.	Blank	5	2	3									0.8
6.	Idle						1	5	4				6.3
7.	Const. Speed							9	1				6.1
8.	Idle					1		4	3	2			6.5
9.	Decel									4	4	2	7.8
10.	Blank	9	1										0.1
11.	Const. Speed						1	5	4				6.3
12.	Idle-Accel								2	2	5	1	9.5
13.	Const. Speed						2	8					5.8
14.	Decel								2	4	4		5.2
15.	Blank	8		2									0.2
16.	Const. Speed							8	2				6.2
17.	Idle-Accel									7	3		8.3
18.	Blank	9		1									0.2
19.	Const. Speed							10					6.0
20.	Idle			1				1	3	3	2		7.1
21.	Blank	7	1		2								0.7
22.	Decel									1	9		8.9
23.	Const. Speed							2	1	7			7.5
24.	Idle. Accel								2	1	7		8.5
25.	Idle						3	4	1		2		6.4

(1) Runs 5, 10, 15, 18 and 21 were conducted without exhaust sample.

TABLE 10B. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Bus 680
Date: January 6, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"B" Burnt Responses					
No. (1)	Condition	0	0.5	1	2	3	Average
1.	Decel				4	6	2.6
2.	Const. Speed				9	1	2.1
3.	Const. Speed				7	3	2.3
4.	Idle-Accel			1	3	6	2.5
5.	Blank	9		1			0.1
6.	Idle			1	7	2	2.1
7.	Const. Speed				9	1	2.1
8.	Idle			3	4	3	2.0
9.	Decel				1	9	2.9
10.	Blank	9	1				0.1
11.	Const. Speed			1	8	1	2.0
12.	Idle-Accel				1	9	2.9
13.	Const. Speed			2	4	4	2.2
14.	Decel			1		9	2.8
15.	Blank	10					0
16.	Const. Speed			2	8		1.8
17.	Idle-Accel				1	9	2.9
18.	Blank	10					0
19.	Const. Speed				10		2.0
20.	Idle	1			3	6	2.4
21.	Blank	9		1			0.2
22.	Decel					10	3.0
23.	Const. Speed				3	7	2.7
24.	Idle-Accel				1	9	2.9
25.	Idle			1	5	4	2.3

(1) Runs 5, 10, 15, 18, and 21 were conducted without exhaust sample.

TABLE 10C. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Bus 680
Date: January 6, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"O" Oily Responses					
No. (1)	Condition	0	1	2	3	4	Average
1.	Decel		1	5	4		2.3
2.	Const. Speed		3	7			1.7
3.	Const. Speed		1	9			1.9
4.	Idle-Accel		2	3	5		2.3
5.	Blank	7	3				0.3
6.	Idle		3	7			1.7
7.	Const. Speed		4	6			1.6
8.	Idle	3	2	2	3		1.5
9.	Decel			5	5		2.5
10.	Blank	10					0
11.	Const. Speed		2	7	1		1.9
12.	Idle-Accel		1	1	7	1	2.8
13.	Const. Speed		4	6			1.6
14.	Decel			3	7		2.7
15.	Blank	10					0
16.	Const. Speed			10			2.0
17.	Idle-Accel			3	5	2	2.9
18.	Blank	10					0
19.	Const. Speed		1	9			1.9
20.	Idle		3	2	5		2.2
21.	Blank	10					0
22.	Decel			2	6	2	3.0
23.	Const. Speed		2	2	6		2.4
24.	Idle-Accel			3	6	1	2.8
25.	Idle		3	5	2		1.9

(1) Runs 5, 10, 15, 18, and 21 were conducted without exhaust sample.

TABLE 10D. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 680
Date: January 6, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	3	Average
1.	Decel		1	7	2	2.1
2.	Const. Speed		5	5		1.5
3.	Const. Speed	1	4	5		1.4
4.	Idle-Accel		2	7	1	1.9
5.	Blank	10				0
6.	Idle		6	4		1.4
7.	Const. Speed	1	6	3		1.2
8.	Idle	1	4	5		1.4
9.	Decel			7	3	2.3
10.	Blank	10				0
11.	Const Speed		5	5		1.5
12.	Idle-Accel			8	2	2.2
13.	Const. Speed			9	1	2.1
14.	Decel			8	2	2.2
15.	Blank	9	1			0.1
16.	Const. Speed		2	8		1.8
17.	Idle-Accel		1	7	2	2.1
18.	Blank	10				0
19.	Const. Speed		5	5		1.5
20.	Idle		1	8	1	2.0
21.	Blank	10				0
22.	Decel		2	6	2	2.0
23.	Const. Speed		2	7	1	1.9
24.	Idle-Accel		1	8	1	2.0
25.	Idle	1	6	2	1	1.3

(1) Runs 5, 10, 15, 18, and 21 were conducted without exhaust sample.

TABLE 10E. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Bus 680
Date: January 6, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"P" Pungent Responses				
No. (1)	Condition	0	1	2	3	Average
1.	Decel	2	1	5	2	1.7
2.	Const. Speed	1	7	2		1.1
3.	Const. Speed	1	7	2		1.1
4.	Idle-Accel	3	3	1	3	1.4
5.	Blank	10				0
6.	Idle	2	3	5		1.3
7.	Const. Speed	4	4	2		0.8
8.	Idle	1	1	6	2	1.9
9.	Decel	1	2	3	4	2.0
10.	Blank	9	1			0.1
11.	Const. Speed	3	6	1		0.8
12.	Idle-Accel	3	2	2	3	1.5
13.	Const. Speed	2	7	1		0.9
14.	Decel	1	3	2	4	2.1
15.	Blank	9	1			0.1
16.	Const. Speed	1	8	1		1.0
17.	Idle-Accel		3	7		1.7
18.	Blank	10				0
19.	Const. Speed	4	1	5		1.1
20.	Idle	1	4	1	4	1.8
21.	Blank	10				0
22.	Decel		2	3	5	2.3
23.	Const. Speed	3	2	5		1.2
24.	Idle-Accel	2	1	4	3	1.8
25.	Idle	2	5	2	1	1.2

(1) Runs 5, 10, 15, 18, and 21 were conducted without exhaust sample.

TABLE 11. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Bus 681
Date: January 9, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	Average Panel Responses "D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 1.	Const. Speed	6.9	2.5	2.0	1.1	1.1
13.	" "	7.5	2.7	2.0	1.5	1.7
18.	" "	7.0	2.6	1.9	1.7	1.3
25.	" "	7.2	2.6	1.9	2.1	1.2
		7.2	2.6	2.0	1.6	1.3
II. 4.	Const. Speed	6.2	2.2	1.6	1.1	0.9
9.	" "	6.5	2.2	1.9	1.4	1.1
20.	" "	7.7	2.8	2.5	1.8	1.7
23.	" "	5.8	1.5	1.2	1.0	0.7
		6.3	2.2	1.8	1.3	1.1
III. 6.	Idle	6.6	2.3	1.7	1.8	1.5
11.	"	6.9	2.4	1.9	1.8	1.3
14.	"	7.2	2.6	2.2	1.7	1.5
21.	"	5.9	2.0	1.4	1.5	1.3
		6.4	2.3	1.8	1.7	1.4
IV. 5.	Idle - Accel.	7.4	2.7	2.1	1.7	1.7
7.	" "	8.8	3.0	3.1	2.0	2.2
17.	" "	8.4	2.8	2.8	2.1	2.3
24.	" "	8.3	3.0	2.5	1.9	1.4
		8.2	2.9	2.6	1.9	1.9
V. 2.	Decel.	8.2	3.0	2.5	2.2	1.8
10.	"	8.7	3.0	2.9	1.8	2.1
15.	"	8.0	2.7	2.5	2.1	2.1
22.	"	8.8	2.9	2.5	2.2	2.4
		8.4	2.9	2.6	2.1	2.1

(1) Runs 3, 8, 12, 16, and 19 were conducted without exhaust sample.

TABLE 11 A. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Composite Standard)

Vehicle: Bus 681
Date: January 9, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"D" Composite Responses 0	1	2	3	4	5	6	7	8	9	Average
1.	Const. Speed							2	7	1		6.9
2.	Decel									8	2	8.2
3.	Blank	9	1									0.1
4.	Const. Speed					1		5	4			6.2
5.	Idle-Accel								6	4		7.4
6.	Idle							4	6			6.6
7.	Idle-Accel									2	8	8.8
8	Blank	8	2									0.2
9.	Const. Speed						1	3	6			6.5
10.	Decel								1	1	8	8.7
11.	Idle							1	9			6.9
12.	Blank	7	1			2						0.9
13.	Const. Speed								5	5		7.5
14.	Idle								3	2		7.2
15.	Decel								1	8	1	8.0
16.	Blank	5	5									0.5
17.	Idle-Accel									6	4	8.4
18.	Const. Speed								10			7.0
19.	Blank	2	1		1		3	3				3.7
20.	Const. Speed								4	5	1	7.7
21.	Idle						1	9				5.9
22.	Decel									2	8	8.8
23.	Const. Speed						4	4	2			5.8
24.	Idle-Accel								2	3	5	8.3
25.	Constant Speed								8	2		7.2

(1) Runs 3, 8, 12, 16, and 19 were conducted without exhaust sample.

TABLE 11B. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Bus 681
Date: January 9, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	3	4	Average
1.	Const. Speed			5	5		2.5
2.	Decel			1	8	1	3.0
3.	Blank	9	1				0.1
4.	Const. Speed		1	6	3		2.2
5.	Idle-Accel			3	7		2.7
6.	Idle		1	5	4		2.3
7.	Idle-Accel			1	8	1	3.0
8.	Blank	8	2				0.2
9.	Const. Speed		1	6	3		2.2
10.	Decel			1	8	1	3.0
11.	Idle			6	4		2.4
12.	Blank	8	2				0.2
13.	Const. Speed			4	5	1	2.7
14.	Idle			4	6		2.6
15.	Decel		1	2	6	1	2.7
16.	Blank	8	2				0.2
17.	Idle-Accel			3	6	1	2.8
18.	Const. Speed			4	6		2.6
19.	Blank	2	5	2	1		1.2
20.	Const. Speed			2	8		2.8
21.	Idle		1	8	1		2.0
22.	Decel			2	7	1	2.9
23.	Const. Speed		5	5			1.5
24.	Idle-Accel			1	8	1	3.0
25.	Const. Speed			5	4	1	2.6

(1) Runs 3, 8, 12, 16, and 19 were conducted without exhaust sample.

TABLE 11C. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Bus 681
Date: January 9, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"O" Oily Responses					
		0	1	2	3	4	Average
1.	Const. Speed		3	4	3		2.0
2.	Decel		1	3	6		2.5
3.	Blank	10					0
4.	Const. Speed		4	6			1.6
5.	Idle-Accel		2	5	3		2.1
6.	Idle		4	5	1		1.7
7.	Idle-Accel			1	7	2	3.1
8.	Blank	10					0
9.	Const. Speed		3	5	2		1.9
10.	Decel			2	7	1	2.9
11.	Idle		3	5	2		1.9
12.	Blank	9	1				0.1
13.	Const. Speed	1	1	5	3		2.0
14.	Idle		1	6	3		2.2
15.	Decel			5	5		2.5
16.	Blank	10					0
17.	Idle-Accel		1	1	7	1	2.8
18.	Const. Speed		2	7	1		1.9
19.	Blank	4	3	2	1		1.0
20.	Const. Speed		1	3	6		2.5
21.	Idle	1	4	5			1.4
22.	Decel			5	5		2.5
23.	Const. Speed	2	4	4			1.2
24.	Idle-Accel			5	5		2.5
25.	Const. Speed		2	7	1		1.9

(1) Runs 3, 8, 12, 16, and 19 were conducted without exhaust sample.

TABLE 11D. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 681
Date: January 9, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"A" Aromatic Responses				
		0	1	2	3	Average
1.	Const. Speed	3	3	4		1.1
2.	Decel		2	4	4	2.2
3.	Blank	10				0
4.	Const. Speed	2	5	3		1.1
5.	Idle-Accel		3	7		1.7
6.	Idle		3	6	1	1.8
7.	Idle-Accel		3	4	3	2.0
8.	Blank	10				0
9.	Const. Speed	1	4	5		1.4
10.	Decel		4	4	2	1.8
11.	Idle		4	4	2	1.8
12.	Blank	9	1			0.1
13.	Const. Speed		6	3	1	1.5
14.	Idle	1	3	4	2	1.7
15.	Decel		1	7	2	2.1
16.	Blank	8	2			0.2
17.	Idle-Accel		1	7	2	2.1
18.	Const. Speed		3	7		1.7
19.	Blank	4	3	3		0.9
20.	Const. Speed		3	6	1	1.8
21.	Idle	1	4	4	1	1.5
22.	Decel		2	4	4	2.2
23.	Const. Speed	2	6	2		1.0
24.	Idle-Accel		2	7	1	1.9
25.	Const. Speed		2	5	3	2.1

(1) Runs 3, 8, 12, 16, and 19 were conducted without exhaust sample.

TABLE 11E. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Bus 681
Date: January 9, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"P" Pungent Responses				
No. (1)	Condition	0	1	2	3	Average
1.	Const. Speed	1	7	2		1.1
2.	Decel		3	6	1	1.8
3.	Blank	10				0
4.	Const. Speed	2	7	1		0.9
5.	Idle-Accel		5	3	2	1.7
6.	Idle	1	5	2	2	1.5
7.	Idle-Accel			8	2	2.2
8.	Blank	10				0
9.	Const. Speed	2	5	3		1.1
10.	Decel		2	5	3	2.1
11.	Idle	2	3	5		1.3
12.	Blank	10				0
13.	Const. Speed		4	5	1	1.7
14.	Idle	1	4	4	1	1.5
15.	Decel		3	3	4	2.1
16.	Blank	10				0
17.	Idle-Accel			7	3	2.3
18.	Const. Speed		7	3		1.3
19.	Blank	6	3	1		0.5
20.	Const. Speed		4	5	1	1.7
21.	Idle	2	4	3	1	1.3
22.	Decel		1	4	5	2.4
23.	Const. Speed	4	5	1		0.7
24.	Idle-Accel	1	4	5		1.4
25.	Const. Speed	1	6	3		1.2

(1) Runs 3, 8, 12, 16, and 19 were conducted without exhaust sample.

TABLE 12. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Bus 682
Date: January 10, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	Average Panel Responses "D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 1.	Const. Speed	6.5	1.9	1.9	0.9	1.0
3.	" "	6.9	2.1	2.0	1.2	1.2
11.	" "	8.2	2.8	2.8	1.8	1.9
25.	" "	5.6	1.8	1.9	1.4	1.4
		6.8	2.2	2.2	1.3	1.4
II. 5.	Const. Speed	7.1	2.3	2.4	1.3	1.1
9.	" "	7.1	2.4	2.1	1.5	1.4
17.	" "	7.9	2.7	2.9	1.7	1.8
22.	" "	6.8	2.4	2.3	1.6	1.1
		7.2	2.5	2.4	1.5	1.4
III. 6.	Idle	7.6	2.5	2.1	2.0	1.9
10.	"	7.8	2.8	2.6	1.7	1.7
18.	"	7.5	2.6	2.0	1.6	2.1
23.	"	7.5	2.4	2.1	2.0	2.4
		7.6	2.6	2.2	1.8	2.0
IV. 13.	Idle - Accel.	7.5	2.9	2.7	1.8	1.7
15.	" "	8.4	2.8	3.0	2.1	2.2
19.	" "	7.7	2.9	2.7	2.0	2.1
21.	" "	7.9	2.6	2.4	1.8	2.0
		7.9	2.8	2.7	1.9	2.0
V. 2.	Decel.	7.8	2.7	2.4	1.9	1.5
7.	"	8.0	2.8	2.0	1.9	2.0
14.	"	9.1	3.3	2.7	2.4	2.2
24.	"	9.1	3.1	2.8	2.4	2.6
		8.5	3.0	2.5	2.2	2.1

(1) Runs 4, 8, 12, 16, and 20 were conducted without exhaust sample.

TABLE 12 A. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Composite Standard)

Vehicle: Bus 682
Date: January 10, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"D" Composite Responses											
No. (1)	Condition	0	1	2	3	4	5	6	7	8	9	10	Average
1.	Const. Speed							6	3	1			6.5
2.	Decel								2	8			7.8
3.	Const. Speed							4	3	3			6.9
4.	Blank	5	4		1								0.7
5.	Const. Speed							1	7	2			7.1
6.	Idle							1	4	3	2		7.6
7.	Decel								1	8	1		8.0
8.	Blank	4	1	2		3							1.7
9.	Const. Speed								9	1			7.1
10.	Idle							1	2	5	2		7.8
11.	Const. Speed								1	6	3		8.2
12.	Blank	5	1	1		2	1						1.6
13.	Idle-Accel							1	3	6			7.5
14.	Decel									2	5	3	9.1
15.	Idle-Accel								1	4	5		8.4
16.	Blank	6		2	2								1.0
17.	Const. Speed								2	7	1		7.9
18.	Idle							1	3	6			7.5
19.	Idle-Accel								1	3	6		7.7
20.	Blank	8	1	1									0.3
21.	Idle-Accel								4	3	3		7.9
22.	Const. Speed							2	8				6.8
23.	Idle								5	5			7.5
24.	Decel									1	7	2	9.1
25.	Const. Speed		2					3	4	1			5.6

(1) Runs 4, 8, 12, 16 and 20 were conducted without exhaust sample.

TABLE 12B. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt Standard)

Vehicle: Bus 682
Date: January 10, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	3	4	Average
1.	Const. Speed		2	7	1		1.9
2.	Decel			3	7		2.7
3.	Const. Speed		1	7	2		2.1
4.	Blank	6	4				0.4
5.	Const. Speed			7	3		2.3
6.	Idle			5	5		2.5
7.	Decel			2	8		2.8
8.	Blank	5	5				0.5
9.	Const. Speed			6	4		2.4
10.	Idle			2	8		2.8
11.	Const. Speed			2	8		2.8
12.	Blank	7	3				0.3
13.	Idle-Accel			1	9		2.9
14.	Decel				7	3	3.3
15.	Idle-Accel			2	8		2.8
16.	Blank	7	3				0.3
17.	Const. Speed			3	7		2.7
18.	Idle		1	2	7		2.6
19.	Idle-Accel			1	9		2.9
20.	Blank	10					0
21.	Idle-Accel			4	6		2.6
22.	Const. Speed			6	4		2.4
23.	Idle			6	4		2.4
24.	Decel			2	5	3	3.1
25.	Const. Speed	1	1	7	1		1.8

(1) Runs 4, 8, 12, 16, and 20 were conducted without exhaust sample.

TABLE 12C. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Bus 682
Date: January 10, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	3	4	Average
1.	Const. Speed		1	9			1.9
2.	Decel			6	4		2.4
3.	Const. Speed		1	4	5		2.0
4.	Blank		1	9			1.9
5.	Const. Speed			7	2	1	2.4
6.	Idle		1	7	2		2.1
7.	Decel		1	4	5		2.0
8.	Blank	7	2	1			0.4
9.	Const. Speed		2	5	3		2.1
10.	Idle			4	6		2.6
11.	Const. Speed			3	6	1	2.8
12.	Blank	7	2	1			0.4
13.	Idle-Accel			3	7		2.7
14.	Decel			3	7		2.7
15.	Idle-Accel			1	8	1	3.0
16.	Blank	9	1				0.1
17.	Const. Speed			2	7	1	2.9
18.	Idle		1	8	1		2.0
19.	Idle-Accel			4	5	1	2.7
20.	Blank	8	2				0.2
21.	Idle-Accel			6	4		2.4
22.	Const. Speed		1	5	4		2.3
23.	Idle		1	7	2		2.1
24.	Decel			3	6	1	2.8
25.	Const. Speed	1	2	4	3		1.9

(1) Runs 4, 8, 12, 16, and 20 were conducted without exhaust sample.

TABLE 12D. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 682
Date: January 10, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	3	4	Average
1.	Const. Speed	3	5	2			0.9
2.	Decel		2	7	1		1.9
3.	Const. Speed		8	2			1.2
4.	Blank	10					0
5.	Const. Speed		8	1	1		1.3
6.	Idle		3	4	3		2.0
7.	Decel		3	5	2		1.9
8.	Blank	10					0
9.	Const. Speed	1	3	6			1.5
10.	Idle		4	5	1		1.7
11.	Const. Speed		3	6	1		1.8
12.	Blank	9	1				0.1
13.	Idle-Accel		4	4	2		1.8
14.	Decel		1	4	5		2.4
15.	Idle-Accel	1		6	3		2.1
16.	Blank	10					0
17.	Const. Speed		4	5	1		1.7
18.	Idle	1	3	5	1		1.6
19.	Idle-Accel		3	4	3		2.0
20.	Blank	9	1				0.1
21.	Idle-Accel	1	3	3	3		1.8
22.	Const. Speed	1	3	5	1		1.6
23.	Idle		3	4	3		2.0
24.	Decel		2	3	4	1	2.4
25.	Const. Speed	2	3	4	1		1.4

(1) Runs 4, 8, 12, 16, and 20 were conducted without exhaust sample.

TABLE 12E. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Bus 682
Date: January 10, 1967

Operating Conditions: See Table 2
Fuel. Reference No. 1

Run No. (1)	Operating Condition	"P" Pungent Responses				
		0	1	2	3	Average
1.	Const. Speed	1	8	1		1.0
2.	Decel		5	5		1.5
3.	Const. Speed	1	6	3		1.2
4.	Blank	10				0
5.	Const. Speed	2	5	3		1.1
6.	Idle	2	1	3	4	1.9
7.	Decel		2	6	2	2.0
8.	Blank	8	2			0.2
9.	Const. Speed	2	2	6		1.4
10.	Idle		3	7		1.7
11.	Const. Speed	1	1	6	2	1.9
12.	Blank	10				0
13.	Idle-Accel		4	5	1	1.7
14.	Decel		3	2	5	2.2
15.	Idle-Accel		1	6	3	2.2
16.	Blank	10				0
17.	Const. Speed	1	2	5	2	1.8
18.	Idle		2	5	3	2.1
19.	Idle-Accel		1	7	2	2.1
20.	Blank	10				0
21.	Idle-Accel	1	1	5	3	2.0
22.	Const. Speed	1	7	2		1.1
23.	Idle		4	4	2	2.4
24.	Decel		1	2	7	2.6
25.	Const. Speed	2	3	4	1	1.4

(1) Runs 4, 8, 12, 16, and 20 were conducted without exhaust sample.

TABLE 13. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Bus 683
Date: January 11, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 5.	Const. Speed	7.0	2.5	2.1	1.6	1.5
8.	" "	6.4	2.0	1.9	1.7	1.3
19.	" "	7.1	2.5	2.0	1.6	1.6
21.	" "	7.8	2.8	2.5	1.9	2.0
		7.1	2.5	2.1	1.7	1.6
II. 1.	Const. Speed	6.2	2.2	1.9	1.5	0.9
3.	" "	6.4	2.2	2.1	1.7	0.8
10.	" "	7.0	2.4	2.2	2.2	1.3
24.	" "	6.7	2.5	2.5	2.0	1.7
		6.6	2.3	2.2	1.9	1.2
III. 2.	Idle	7.1	2.4	1.5	1.9	1.3
11.	"	7.4	2.4	2.3	2.1	1.6
18.	"	8.6	2.9	2.5	2.5	2.2
25.	"	8.1	2.8	2.5	2.1	2.2
		7.8	2.7	2.2	2.2	1.8
IV. 6.	Idle-Accel	8.5	3.1	2.9	2.1	2.2
14.	" "	7.6	2.9	2.3	1.9	1.9
17.	" "	8.5	2.9	2.9	1.7	2.3
23.	" "	9.0	3.1	3.1	2.3	2.4
		8.4	3.0	2.8	2.0	2.2
V. 7.	Decel	9.0	3.0	2.8	2.4	2.4
13.	"	8.7	3.2	2.7	2.2	2.2
15.	"	8.7	3.1	2.8	2.2	2.3
22.	"	9.2	3.1	3.1	2.5	2.7
		8.9	3.1	2.9	2.3	2.4

(1) Runs 4, 9, 12, 16, and 20 were conducted without exhaust sample.

TABLE 13A. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Composite Standard)

Vehicle: Bus 683
Date: January 11, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"D" Composite Responses 0	1	2	3	4	6	7	8	9	10	Average
1.	Const. Speed						8	2				6.2
2.	Idle						2	5	3			7.1
3.	Const. Speed						6	4				6.4
4.	Blank	6	1	1		2						1.1
5.	Const. Speed						3	4	3			7.0
6.	Idle-Accel								5	5		8.5
7.	Decel								2	6	2	9.0
8.	Const. Speed						6	4				6.4
9.	Blank	7	1	2								0.5
10.	Const. Speed						3	4	3			7.0
11.	Idle						1	6	1	2		7.4
12.	Blank	8	2									0.2
13.	Decel								3	7		8.7
14.	Idle-Accel							4	6			7.6
15.	Decel								3	7		8.7
16.	Blank	5	2	2	1							0.9
17.	Idle-Accel								5	5		8.5
18.	Idle								5	4	1	8.6
19.	Const. Speed						2	6	1	1		7.1
20.	Blank	8		1		1						0.6
21.	Const. Speed							3	6	1		7.8
22.	Decel								1	6	3	9.2
23.	Idle-Accel								2	6	2	9.0
24.	Const. Speed						2	3	2	2		6.7
25.	Idle							1	7	2		8.1

(1) Runs 4, 9, 12, 16, and 20 were conducted without exhaust sample.

TABLE 13B. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Bus 683
Date: January 11, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"B" Burnt Responses					
No. (1)	Condition	0	1	2	3	4	Average
1.	Const. Speed			8	2		2.2
2.	Idle			6	4		2.4
3.	Const. Speed			8	2		2.2
4.	Blank	7	3				0.3
5.	Const. Speed			5	5		2.5
6.	Idle-Accel				9	1	3.1
7.	Decel			1	8	1	3.0
8.	Const. Speed		1	8	1		2.0
9.	Blank	8	2				0.2
10.	Const. Speed			6	4		2.4
11.	Idle		1	5	3	1	2.4
12.	Blank	9	1				0.1
13.	Decel				8	2	3.2
14.	Idle-Accel			1	9		2.9
15.	Decel				9	1	3.1
16.	Blank	7	3				0.3
17.	Idle-Accel			1	9		2.9
18.	Idle			2	7	1	2.9
19.	Const. Speed			6	3	1	2.5
20.	Blank	8	2				0.2
21.	Const. Speed			2	8		2.8
22.	Decel			1	7	2	3.1
23.	Idle-Accel			1	7	2	3.1
24.	Const. Speed		1	4	4	1	2.5
25.	Idle			3	6	1	2.8

(1) Runs 4, 9, 12, 16, and 20 were conducted without exhaust sample.

TABLE 13C. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Bus 683
Date: January 11, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Bus	Operating	"O" Oily Responses					
No. (1)	Condition	0	1	2	3	4	Average
1.	Const. Speed		2	7	1		1.9
2.	Idle		2	5	3		1.5
3.	Const. Speed		3	3	4		2.1
4.	Blank	8	2				0.2
5.	Const. Speed		1	7	2		2.1
6.	Idle-Accel			1	9		2.9
7.	Decel			2	8		2.8
8.	Const. Speed		1	9			1.9
9.	Blank	9	1				0.1
10.	Const. Speed		2	4	4		2.2
11.	Idle		1	5	4		2.3
12.	Blank	9	1				0.1
13.	Decel			3	7		2.7
14.	Idle-Accel		1	5	4		2.3
15.	Decel			2	8		2.8
16.	Blank	6	4				0.4
17.	Idle-Accel			1	9		2.9
18.	Idle			5	5		2.5
19.	Const. Speed		1	8	1		2.0
20.	Blank	9	1				0.1
21.	Const. Speed			5	5		2.5
22.	Decel				9	1	3.1
23.	Idle-Accel				9	1	3.1
24.	Const. Speed		1	4	4	1	2.5
25.	Idle			5	5		2.5

(1) Runs 4, 9, 12, 16, and 20 were conducted without exhaust sample.

TABLE 13D. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 683
Date: January 11, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	("A" Aromatic Responses) 0	1	2	3	Average
1.	Const. Speed		5	5		1.5
2.	Idle		3	5	2	1.9
3.	Const. Speed		3	7		1.7
4.	Blank	8	2			0.2
5.	Const. Speed		4	6		1.6
6.	Idle-Accel		2	5	3	2.1
7.	Decel			6	4	2.4
8.	Const. Speed	1	1	8		1.7
9.	Blank	10				0
10.	Const. Speed	1		5	4	2.2
11.	Idle		2	5	3	2.1
12.	Blank	10				0
13.	Decel	1		5	4	2.2
14.	Idle-Accel		2	7	1	1.9
15.	Decel			8	2	2.2
16.	Blank	9	1			0.1
17.	Idle-Accel	2	1	5	2	1.7
18.	Idle		1	3	6	2.5
19.	Const. Speed	1	3	5	1	1.6
20.	Blank	9	1			0.1
21.	Const. Speed		3	5	2	1.9
22.	Decel		1	3	6	2.5
23.	Idle-Accel		2	3	5	2.3
24.	Const. Speed		1	8	1	2.0
25.	Idle		1	7	2	2.1

(1) Runs 4, 9, 12, 16 and 20 were conducted without exhaust sample.

TABLE 13E. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Bus 683
Date: January 11, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	2	3	Average
1.	Const. Speed	2	7	1		0.9
2.	Idle		7	3		1.3
3.	Const. Speed	2	8			0.8
4.	Blank	9	1			0.1
5.	Const. Speed		5	5		1.5
6.	Idle-Accel		2	4	4	2.2
7.	Decel		2	2	6	2.4
8.	Const. Speed		7	3		1.3
9.	Blank	10				0
10.	Const. Speed		7	3		1.3
11.	Idle		5	4	1	1.6
12.	Blank	10				0
13.	Decel		1	6	3	2.2
14.	Idle-Accel		4	3	3	1.9
15.	Decel		1	5	4	2.3
16.	Blank	9	1			0.1
17.	Idle-Accel		3	1	6	2.3
18.	Idle		1	6	3	2.2
19.	Const. Speed		4	6		1.6
20.	Blank	10				0
21.	Const. Speed		2	6	2	2.0
22.	Decel			3	7	2.7
23.	Idle-Accel		1	4	5	2.4
24.	Const. Speed	1	2	6	1	1.7
25.	Idle		2	4	4	2.2

(1) Runs 4, 9, 12, 16 and 20 were conducted without exhaust sample.

TABLE 14. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Bus 684
Date: January 12, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 6.	Const. Speed	5.0	1.6	1.5	1.0	0.6
8.	" "	5.2	1.3	1.2	0.8	0.4
12.	" "	6.1	1.9	1.8	1.4	0.6
21.	" "	6.7	2.1	2.0	1.7	1.1
		5.8	1.7	1.6	1.2	0.7
II. 2.	Const. Speed	5.2	1.3	1.0	0.8	0.5
17.	" "	7.7	2.6	2.2	1.8	1.3
20.	" "	7.4	2.6	2.5	1.7	1.4
24.	" "	7.0	2.6	2.3	1.6	1.2
		6.8	2.3	2.0	1.5	1.1
III. 5.	Idle	6.0	2.0	1.7	1.3	0.9
13.	"	6.9	2.2	2.0	1.6	1.5
18.	"	7.5	2.5	2.2	2.2	1.5
23.	"	6.7	2.5	2.2	1.7	1.1
		6.8	2.3	2.0	1.7	1.3
IV. 4.	Idle-Accel	8.0	3.0	1.6	1.7	1.5
10.	" "	6.7	2.1	2.0	1.5	1.3
15.	" "	6.4	1.9	1.8	1.6	0.9
25.	" "	7.8	3.1	2.7	2.0	1.9
		7.2	2.5	2.0	1.7	1.4
V. 1.	Decel	6.4	2.0	1.8	1.0	0.6
9.	"	4.2	1.0	0.9	0.2	0.3
16.	"	4.3	1.0	0.9	1.1	0.1
22.	"	4.2	1.1	1.0	0.6	0
		5.0	1.3	1.3	0.7	0.3

(1) Runs 3, 7, 11, 14, and 19 were conducted without exhaust sample.

TABLE 14A. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Composite Standard)

Vehicle: Bus 684
Date: January 12, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"D" Composite Responses						
No. (1)	Condition	0	4	5	6	7	8	Average
1.	Decel				6	4		6.4
2.	Const. Speed			8	2			5.2
3.	Blank	10						0
4.	Idle-Accel						10	8.0
5.	Idle				10			6.0
6.	Const. Speed			4	5			5.0
7.	Blank	10						0
8.	Const. Speed			8	2			5.2
9.	Decel		9		1			4.2
10.	Idle-Accel				3	7		6.7
11.	Blank	10						0
12.	Const. Speed			1	7	2		6.1
13.	Idle				1	9		6.9
14.	Blank	10						0
15.	Idle-Accel				6	4		6.4
16.	Decel		7	3				4.3
17.	Const. Speed					3	7	7.7
18.	Idle			1	1		8	7.5
19.	Blank	10						0
20.	Const. Speed				3		7	7.4
21.	Const. Speed				3	7		6.7
22.	Decel		9		1			4.2
23.	Idle				3	7		6.7
24.	Const. Speed				4	2	4	7.0
25.	Idle-Accel					2	8	7.8

(1) Runs 3, 7, 11, 14, and 19 were conducted without exhaust sample.

TABLE 14B. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Bus 684
Date: January 12, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"B" Burnt Responses					
		0	1	2	3	4	Average
1.	Decel			10			2.0
2.	Const. Speed		7	3			1.3
3.	Blank	10					0
4.	Idle-Accel			1	8	1	3.0
5.	Idle		1	8	1		2.0
6.	Const. Speed		4	6			1.6
7.	Blank	10					0
8.	Const. Speed	1	5	4			1.3
9.	Decel	1	8	1			1.0
10.	Idle-Accel			9	1		2.1
11.	Blank	10					0
12.	Const. Speed		2	7	1		1.9
13.	Idle		1	6	3		2.2
14.	Blank	10					0
15.	Idle-Accel	1		8	1		1.9
16.	Decel		10				1.0
17.	Const. Speed			5	4	1	2.6
18.	Idle		1	3	6		2.5
19.	Blank	10					0
20.	Const. Speed			4	6		2.6
21.	Const. Speed		1	7	2		2.1
22.	Decel		9	1			1.1
23.	Idle			5	5		2.5
24.	Const. Speed			5	4	1	2.6
25.	Idle-Accel				9	1	3.1

(1) Runs 3, 7, 11, 14, and 19 were conducted without exhaust sample.

TABLE 14C. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS

("O" Oily Standard)

Vehicle: Bus 684
Date: January 12, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	3	4	Average
1.	Decel		2	8			1.8
2.	Const. Speed	1	8	1			1.0
3.	Blank	10					0
4.	Idle-Accel			3	7		1.6
5.	Idle		3	7			1.7
6.	Const. Speed		5	5			1.5
7.	Blank	10					0
8.	Const. Speed	1	6	3			1.2
9.	Decel	1	9				0.9
10.	Idle-Accel		1	8	1		2.0
11.	Blank	10					0
12.	Decel		2	8			1.8
13.	Idle		2	6	2		2.0
14.	Blank	10					0
15.	Idle-Accel		3	6	1		1.8
16.	Decel	2	7	1			0.9
17.	Const. Speed		2	5	2	1	2.2
18.	Idle		2	4	4		2.2
19.	Blank	10					0
20.	Const. Speed		1	3	6		2.5
21.	Const. Speed		1	8	1		2.0
22.	Decel		10				1.0
23.	Idle			8	2		2.2
24.	Const. Speed		1	6	2	1	2.3
25.	Idle-Accel			4	5	1	2.7

(1) Runs 3, 7, 11, 14, and 19 were conducted without exhaust sample.

TABLE 14D. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 684
Date: January 12, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"A" Aromatic Responses					
No. (1)	Condition	0	1	2	3	4	Average
1.	Decel	2	6	2			1.0
2.	Const. Speed	2	8				0.8
3.	Blank	10					0
4.	Idle-Accel		4	5	1		1.7
5.	Idle		8	1	1		1.3
6.	Const. Speed	2	6	2			1.0
7.	Blank	10					0
8.	Const. Speed	2	8				0.8
9.	Decel	8	2				0.2
10.	Idle-Accel		6	3	1		1.5
11.	Blank	10					0
12.	Const. Speed		6	4			1.4
13.	Idle	1	3	5	1		1.6
14.	Blank	10					0
15.	Idle-Accel		6	2	2		1.6
16.	Decel	3	4	2	1		1.1
17.	Const. Speed		3	6	1		1.8
18.	Idle		1	6	3		2.2
19.	Blank	10					0
20.	Const. Speed	1	1	8			1.7
21.	Const. Speed		4	5	1		1.7
22.	Decel	5	4	1			0.6
23.	Idle		4	5	1		1.7
24.	Const. Speed	1	3	5	1		1.6
25.	Idle-Accel	1		8		1	2.0

(1) Runs 3, 7, 11, 14, and 19 were conducted without exhaust sample.

TABLE 14E. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS

("P" Pungent Standard)

Vehicle: Bus 684
Date: January 12, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	2	3	Average
1.	Decel	5	4	1		0.6
2.	Const. Speed	6	3	1		0.5
3.	Blank	10				0
4.	Idle-Accel	1	3	6		1.5
5.	Idle	2	7	1		0.9
6.	Const. Speed	4	6			0.6
7.	Blank	10				0
8.	Const. Speed	6	4			0.4
9.	Decel	8	1	1		0.3
10.	Idle-Accel		7	3		1.3
11.	Blank	10				0
12.	Const. Speed	4	6			0.6
13.	Idle	1	3	6		1.5
14.	Blank	10				0
15.	Idle-Accel	3	5	2		0.9
16.	Decel	9	1			0.1
17.	Const. Speed	1	5	4		1.3
18.	Idle	2	2	5	1	1.5
19.	Blank	10				0
20.	Const. Speed	2	3	4	1	1.4
21.	Const. Speed	3	4	2	1	1.1
22.	Decel	10				0
23.	Idle	1	7	2		1.1
24.	Const. Speed	3	2	6		1.2
25.	Idle-Accel	1	1	6	2	1.9

(1) Runs 3, 7, 11, 14 and 19 were conducted without exhaust sample.

TABLE 15. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Bus 685
Date: January 13, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

			Average Panel Responses				
	Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I.	2.	Const. Speed	5.9	1.7	1.7	1.1	0.8
	8.	" "	5.7	1.8	1.8	1.6	0.9
	14.	" "	5.2	1.6	1.5	0.9	0.5
	23.	" "	6.6	2.3	2.1	1.6	1.0
			5.9	1.9	1.8	1.3	0.8
II.	1.	Const. Speed	6.6	2.2	2.0	1.1	1.3
	7.	" "	6.3	2.3	1.9	1.4	0.8
	10.	" "	7.7	2.7	2.6	1.6	1.6
	25.	" "	6.7	2.3	2.1	1.2	1.2
			6.8	2.4	2.2	1.3	1.2
III.	4.	Idle	7.8	2.7	2.5	1.9	1.9
	11.	"	8.2	3.0	2.6	2.4	1.2
	18.	"	7.8	2.5	2.3	2.3	1.7
	24.	"	6.4	2.0	1.8	1.2	1.4
			7.6	2.6	2.4	2.0	1.6
IV.	6.	Idle-Accel	6.9	2.4	2.3	1.6	1.5
	13.	" "	7.0	1.9	2.0	2.7	1.1
	17.	" "	8.1	2.6	1.8	1.7	2.0
	22.	" "	7.5	2.5	2.6	1.6	1.8
			7.4	2.4	2.2	1.9	1.4
V.	5.	Decel	7.1	2.4	2.1	1.5	1.7
	15.	"	8.2	2.6	2.6	2.4	1.4
	19.	"	6.4	1.8	1.9	1.5	1.4
	21.	"	6.4	2.0	1.8	1.5	1.6
			7.0	2.2	2.1	1.7	1.5

(1) Runs 3, 9, 12, 16, and 20 were conducted without exhaust sample.

TABLE 15A. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Composite Standard)

Vehicle: Bus 685
Date: January 13, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"D" Composite Responses											
		0	1	2	3	4	5	6	7	8	9	10	Average
1.	Const. Speed							5	4	1			6.6
2.	Const. Speed				1		1	5	3				5.9
3.	Blank	10											0
4.	Idle								2	8			7.8
5.	Decel							2	5	3			7.1
6.	Idle-Accel							1	9				6.9
7.	Const. Speed						1	5	4				6.3
8.	Const. Speed						5	3	2				5.7
9.	Blank	5	3		2								0.9
10.	Const. Speed								3	7			7.7
11.	Idle									8	2		8.2
12.	Blank	6	4										0.4
13.	Idle-Accel								10				7.0
14.	Const. Speed					1	6	3					5.2
15.	Decel								1	6	3		8.2
16.	Blank	8	1					1					0.7
17.	Idle-Accel							1	2	3	3	1	8.1
18.	Idle								4	4	2		7.8
19.	Decel						3	2	3	2			6.4
20.	Blank	10											0
21.	Decel			1				2	6	1			6.4
22.	Idle-Accel								5	5			7.5
23.	Const. Speed							5	4	1			6.6
24.	Idle				1	1	1	1	2	4			6.4
25.	Const. Speed							4	5	1			6.7

(1) Runs 3, 9, 12, 16, and 20 were conducted without exhaust sample.

TABLE 15B. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Bus 685
Date: January 13, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"B" Burnt Responses					
		0	1	2	3	4	Average
1.	Const. Speed			8	2		2.2
2.	Const. Speed	1	1	8			1.7
3.	Blank	10					0
4	Idle			4	5	1	2.7
5.	Decel			6	4		2.4
6.	Idle-Accel		1	4	5		2.4
7.	Const. Speed			7	3		2.3
8.	Const. Speed		3	6	1		1.8
9.	Blank	7	3				0.3
10.	Const. Speed			3	7		2.7
11.	Idle			1	8	1	3.0
12.	Blank	9	1				0.1
13.	Idle-Accel	1	1	6	2		1.9
14.	Const. Speed		4	6			1.6
15.	Decel	1		2	6	1	2.6
16.	Blank	9		1			0.2
17.	Idle-Accel			4	6		2.6
18.	Idle			6	3	1	2.5
19.	Decel	1	3	3	3		1.8
20.	Blank	10					0
21.	Decel		1	8	1		2.0
22.	Idle-Accel		1	4	4	1	2.5
23.	Const. Speed			7	3		2.3
24.	Idle		3	4	3		2.0
25.	Const. Speed		1	5	4		2.3

(1) Runs 3, 9, 12, 16, and 20 were conducted without exhaust sample.

TABLE 15C. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Bus 685
Date: January 13, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	3	4	Average
1.	Const. Speed		1	8	1		2.0
2.	Const. Speed		3	7			1.7
3.	Blank	10					0
4.	Idle		1	3	6		2.5
5.	Decel			9	1		2.1
6.	Idle-Accel			7	3		2.3
7.	Const. Speed		2	7	1		1.9
8.	Const. Speed		3	6	1		1.8
9.	Blank	8	2				0.2
10.	Const. Speed			4	6		2.6
11.	Idle			5	4	1	2.6
12.	Blank	10					0
13.	Idle-Accel		2	6	2		2.0
14.	Const. Speed	1	3	6			1.5
15.	Decel			5	4	1	2.6
16.	Blank	9		1			0.2
17.	Idle-Accel		1	5	4		1.8
18.	Idle			7	3		2.3
19.	Decel		3	5	2		1.9
20.	Blank	10					0
21.	Decel	1	1	7	1		1.8
22.	Idle-Accel			5	4	1	2.6
23.	Const. Speed		2	5	3		2.1
24.	Idle		4	4	2		1.8
25.	Const. Speed		3	4	2	1	2.1

(1) Runs 3, 9, 12, 16 and 20 were conducted without exhaust sample.

TABLE 15D. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 685
Date: January 13, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	3	4	Average
1.	Const. Speed	4	2	3	1		1.1
2.	Const. Speed	3	3	4			1.1
3.	Blank	10					0
4.	Idle	1	1	6	2		1.9
5.	Decel	1	4	4	1		1.5
6.	Idle-Accel	1	3	5	1		1.6
7.	Const. Speed	1	4	5			1.4
8.	Const. Speed		5	4	1		1.6
9.	Blank	9	1				0.1
10.	Const. Speed	1	4	3	2		1.6
11.	Idle		2	3	4	1	2.4
12.	Blank	9	1				0.1
13.	Idle-Accel			4	5	1	2.7
14.	Const. Speed	2	7	1			0.3
15.	Decel		2	3	4	1	2.4
16.	Blank	8	1	1			0.3
17.	Idle-Accel		5	3	2		1.7
18.	Idle		2	3	5		2.3
19.	Decel	1	3	6			1.5
20.	Blank	9		1			0.2
21.	Decel	2	2	5	1		1.5
22.	Idle-Accel	1	2	7			1.6
23.	Const. Speed		5	4	1		1.6
24.	Idle	3	2	5			1.2
25.	Const. Speed	1	6	3			1.2

(1) Runs 3, 9, 12, 16 and 20 were conducted without exhaust sample.

TABLE 15E. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Bus 685
Date: January 13, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"P" Pungent Responses				
		0	1	2	3	Average
1.	Const. Speed	1	5	4		1.3
2.	Const. Speed	3	6	1		0.8
3.	Blank	10				0
4.	Idle		2	7	1	1.9
5.	Decel		4	5	1	1.7
6.	Idle-Accel		5	5		1.5
7.	Const. Speed	2	8			0.8
8.	Const. Speed	2	7	1		0.9
9.	Blank	9	1			0.1
10.	Const. Speed		4	6		1.6
11.	Idle	1	6	3		1.2
12.	Blank	10				0
13.	Idle-Accel	2	5	3		1.1
14.	Const. Speed	6	3	1		0.5
15.	Decel		6	4		1.4
16.	Blank	10				0
17.	Idle-Accel	1	2	3	4	2.0
18.	Idle	1	3	4	2	1.7
19.	Decel	1	5	3	1	1.4
20.	Blank	10				0
21.	Decel	2	2	4	2	1.6
22.	Idle-Accel		2	8		1.8
23.	Const. Speed	1	8	1		1.0
24.	Idle	3	1	5	1	1.4
25.	Const. Speed	1	6	3		1.2

(1) Runs 3, 9, 12, 16 and 20 were conducted without exhaust sample.

TABLE 16. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Bus 695
Date: January 16, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	Average Panel Responses "D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 5.	Const. Speed	7.0	2.5	1.9	0.8	0.8
8.	" "	6.4	2.1	1.7	0.8	0.9
19.	" "	7.1	2.2	2.1	1.3	1.3
21.	" "	7.6	1.9	2.4	1.6	1.7
		7.0	2.2	2.0	1.1	1.2
II. 1.	Const. Speed	8.2	2.0	2.4	1.1	1.5
3.	" "	7.4	2.3	2.2	1.4	1.3
10.	" "	7.6	2.9	2.2	1.8	1.6
24.	" "	8.6	3.1	2.5	1.1	2.0
		8.0	2.8	2.3	1.4	1.6
III. 2.	Idle	7.6	2.5	1.9	1.5	0.9
11.	"	7.6	2.8	2.2	1.7	1.2
18.	"	7.5	2.6	2.3	2.2	1.8
25.	"	7.4	2.4	2.4	2.0	1.4
		7.5	2.6	2.2	1.9	1.3
IV. 6.	Idle-Accel	7.1	2.2	2.4	1.6	1.1
14.	" "	7.4	2.3	2.2	1.7	1.4
17.	" "	8.3	1.9	2.3	1.6	1.8
23.	" "	8.1	3.1	2.7	1.9	1.1
		7.7	2.6	2.4	1.7	1.4
V. 7.	Decel	8.5	2.4	2.3	1.1	1.5
13.	"	7.6	2.4	2.2	1.4	1.3
15.	"	8.5	2.9	2.7	1.8	1.6
22.	"	8.0	2.8	2.4	1.1	2.0
		8.2	2.7	2.4	1.4	1.6

(1) Runs 4, 9, 12, 16, and 20 were conducted without exhaust sample.

TABLE 16A. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Diesel Composite Standard)

Vehicle: Bus 695
Date: January 16, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"D" Composite Responses										Average
		0	1	2	3	4	5	6	7	8	9	
1.	Const. Speed									8	2	8.2
2.	Idle								4	6		7.6
3.	Const. Speed							1	6	1	2	7.4
4.	Blank	6	1	1		2						1.1
5.	Const. Speed							3	4	3		7.0
6.	Idle-Accel							2	6	1	1	7.1
7.	Decel									5	5	8.5
8.	Const. Speed							6	4			6.4
9.	Blank	7	1	2								0.5
10.	Const. Speed								4	6		7.6
11.	Idle								4	6		7.6
12.	Blank	8	2									0.2
13.	Decel								4	6		7.6
14.	Idle-Accel							1	6	1	2	7.4
15.	Decel									5	5	8.5
16.	Blank	5	2	2	1							0.9
17.	Idle-Accel								2	3	5	8.3
18.	Idle							3	1	4	2	7.5
19.	Const. Speed							1	6	1	2	7.1
20.	Blank	8			2							0.6
21.	Const. Speed								4	6		7.6
22.	Decel								2	6	2	8.0
23.	Idle-Accel								1	7	2	8.1
24.	Const. Speed									4	6	8.6
25.	Idle							1	6	1	2	7.4

(1) Runs 4, 9, 12, 16, and 20 were conducted without exhaust sample.

TABLE 16B. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Bus 695
Date: January 16, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"B" Burnt-Smoky Responses 0	1	2	3	4	Average
1.	Const. Speed			1	9		2.9
2.	Idle			5	5		2.5
3.	Const. Speed		1	5	4		2.3
4.	Blank	7	3				0.2
5.	Const. Speed			5	5		2.5
6.	Idle-Accel			8	2		2.2
7.	Decel			6	4		2.4
8.	Const. Speed		1	7	2		2.1
9.	Blank	8	2				0.2
10.	Const. Speed			1	9		2.9
11.	Idle			2	8		2.8
12	Blank	8	2				0.2
13.	Decel			6	4		2.4
14.	Idle-Accel		1	5	4		2.3
15.	Decel			1	9		2.9
16.	Blank	7	3				0.3
17.	Idle-Accel		2	7	1		1.9
18.	Idle			5	4	1	2.6
19.	Const. Speed			8	2		2.2
20.	Blank	8	2				0.2
21.	Const. Speed		2	7	1		1.9
22.	Decel			2	6	2	2.8
23.	Idle-Accel				9	1	3.1
24.	Const. Speed				9	1	3.1
25.	Idle			6	4		2.4

(1) Runs 4, 9, 12, 16 and 20 were conducted without exhaust sample.

TABLE 16C. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Bus 695
Date: January 16, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"O" Oily Responses					
		0	1	2	3	4	Average
1.	Const. Speed		9	1			1.1
2.	Idle		2	5	3		1.5
3.	Const. Speed	1	4	5			1.4
4.	Blank	8	2				0.2
5.	Const. Speed		2	7	1		1.9
6.	Idle-Accel			6	4		2.4
7.	Decel		1	5	4		2.3
8.	Const. Speed			3	7		1.7
9.	Blank	9	1				0.1
10.	Const. Speed		1	6	3		2.2
11.	Idle		1	6	3		2.2
12.	Blank	9	1				0.1
13.	Decel		2	4	4		2.2
14.	Idle-Accel		1	6	3		2.2
15.	Decel	1			9		2.7
16.	Blank	6	4				0.4
17.	Idle-Accel		1	5	4		2.3
18.	Idle		1	5	4		2.3
19.	Const. Speed		1	7	2		2.1
20.	Blank	9	1				0.1
21.	Const. Speed			6	4		2.4
22.	Decel			6	4		2.4
23.	Idle-Accel	1			9		2.7
24.	Const. Speed		1	4	4	1	2.5
25.	Idle			6	4		2.4

(1) Runs 4, 9, 12, 16 and 20 were conducted without exhaust sample.

TABLE 16D. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Bus 695
Date: January 16, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run	Operating	"A" Aromatic Responses				
No. (1)	Condition	0	1	2	3	Average
1.	Const. Speed		9	1		1.1
2.	Idle		5	5		1.5
3.	Const. Speed	3		7		1.4
4.	Blank	8	2			0.2
5.	Const. Speed	5	2	3		0.8
6.	Idle-Accel		4	6		1.6
7.	Decel		9	1		1.1
8.	Const. Speed	5	2	3		0.8
9.	Blank	9	1			0.1
10.	Const. Speed	1		9		1.8
11.	Idle	1	2	6	1	1.7
12.	Blank	9	1			0.1
13.	Decel	3		7		1.4
14.	Idle-Accel	6	4			0.4
15.	Decel		5	5		1.5
16.	Blank	9	1			0.1
17.	Idle-Accel	1	2	6	1	1.7
18.	Idle		2	4	4	2.2
19.	Const. Speed		7	3		1.3
20.	Blank	9	1			0.1
21.	Const. Speed		4	6		1.6
22.	Decel		9	1		1.1
23.	Idle-Accel		3	5	2	1.9
24.	Const. Speed		9	1		1.1
25.	Idle			10		2.0

(1) Runs 4, 9, 12, 16 and 20 were conducted without exhaust sample.

TABLE 16E. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Bus 695
Date: January 16, 1967

Operating Conditions: See Table 2
Fuel: Reference No. 1

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	2	3	Average
1.	Const. Speed		5	5		1.5
2.	Idle	1	9			0.9
3.	Const. Speed		7	3		1.3
4.	Blank	9	1			0.1
5.	Const. Speed	2	8			0.8
6.	Idle-Accel		9	1		1.1
7.	Decel		5	5		1.5
8.	Const. Speed	1	9			0.9
9.	Blank	10				0
10.	Const. Speed		4	6		1.6
11.	Idle	4		6		1.2
12.	Blank	10				0
13.	Decel		7	3		1.3
14.	Idle-Accel	3		7		1.4
15.	Decel		4	6		1.6
16.	Blank	9	1			0.1
17.	Idle-Accel		2	8		1.8
18.	Idle		2	8		1.8
19.	Const. Speed		7	3		1.3
20.	Blank	10				0
21.	Const. Speed	4		1	5	1.7
22.	Decel			10		2.0
23.	Idle-Accel		9	1		1.1
24.	Const. Speed			10		2.0
25.	Idle	3		7		1.4

(1) Runs 4, 9, 12, 16 and 20 were conducted without exhaust sample.

TABLE 17. SUMMARY OF BUS VARIABILITY STUDY ODOR EVALUATION RESULTS

Operating	Odor				Municipal Bus Series							Overall
Condition (1)	Quality (2)	1	2	3	4	5	6	7	8	9	10	Average
I.	D	7.1	6.6	6.6	6.1	7.2	6.8	7.1	5.8	5.9	7.0	6.6
II.	D	7.1	7.2	7.8	6.5	6.3	7.2	6.6	6.8	6.8	8.0	7.0
III.	D	7.7	7.1	7.3	6.6	6.4	7.6	7.8	6.8	7.6	7.5	7.2
IV.	D	7.3	8.1	8.4	8.5	8.2	7.9	8.4	7.2	7.4	7.7	7.9
V.	D	7.8	7.7	7.5	7.3	8.4	8.5	8.9	5.0	7.0	8.2	7.6
I.	B	2.5	2.2	2.0	2.2	2.6	2.2	2.5	1.7	1.9	2.2	2.4
II.	B	2.3	2.4	2.6	2.2	2.2	2.5	2.3	2.3	2.4	2.8	2.4
III.	B	2.6	2.7	2.4	2.2	2.3	2.6	2.7	2.3	2.6	2.6	2.5
IV.	B	2.4	3.0	2.9	2.8	2.9	2.8	3.0	2.5	2.4	2.6	2.7
V.	B	2.9	2.8	2.5	2.8	2.9	3.0	3.1	1.3	2.2	2.7	2.6
I.	O	2.1	1.9	1.9	1.8	2.0	2.2	2.1	1.6	1.8	2.0	1.9
II.	O	2.1	2.3	2.4	2.0	1.8	2.4	2.2	2.0	2.2	2.3	2.2
III.	O	2.0	1.9	2.0	1.8	1.8	2.2	2.2	2.0	2.4	2.2	2.1
IV.	O	2.4	2.6	2.5	2.7	2.6	2.7	2.8	2.0	2.2	2.4	2.5
V.	O	2.3	2.3	2.1	2.6	2.6	2.5	2.9	1.3	2.1	2.4	2.3
I.	A	1.5	1.3	1.5	1.6	1.6	1.3	1.7	1.2	1.3	1.1	1.4
II.	A	1.4	1.8	2.0	1.7	1.3	1.5	1.9	1.5	1.3	1.4	1.6
III.	A	1.7	1.9	1.8	1.5	1.7	1.8	2.2	1.7	2.0	1.9	1.8
IV.	A	1.7	2.1	2.0	2.1	1.9	1.9	2.0	1.7	1.9	1.7	1.9
V.	A	2.1	2.1	1.7	2.2	2.1	2.2	2.3	0.7	1.7	1.4	1.9
I.	P	1.1	1.0	1.0	1.0	1.3	1.4	1.6	0.7	0.8	1.2	1.1
II.	P	1.2	1.3	1.6	1.1	1.1	1.4	1.2	1.1	1.2	1.6	1.3
III.	P	1.5	1.6	1.3	1.6	1.4	2.0	1.8	1.3	1.6	1.3	1.5
IV.	P	1.4	1.9	2.0	1.6	1.9	2.0	2.2	1.4	1.4	1.4	1.7
V.	P	1.5	1.8	1.5	2.1	2.1	2.1	2.4	0.3	1.5	1.6	1.7

(1) I. Constant speed at 20 mph, 40 Hp
II. Constant speed at 40 mph, 40 Hp
III. Idle after constant speed operation
IV. Acceleration after one minute idle
V. Deceleration after constant speed

(2) "D" Diesel Composite Results
"B" Burnt-Smoky Results
"O" Oily Results
"A" Aromatic Results
"P" Pungent Results

TABLE 18. CITY BUS VEHICLE VARIABILITY SMOKE EVALUATION CONDITIONS

Vehicle Data:	GM Truck and Coach Model TDH-4519 City Bus powered by 2-cycle Detroit Diesel 6V-71 E Series 2-valve engine. Muffler under coach.
Measurement Method:	U. S. Public Health Service full-flow light extinction type smokemeter
Inertia:	Full inertia simulation via SwRI system.

OPERATING CONDITIONS

Type of Operation	Vehicle Speed, mph	Vehicle Load, hp	For Details Refer to:
A - Constant Speed	20	Open Rack	Table 19
B - Constant Speed	25	Open Rack	Table 19
C - Constant Speed	30	Open Rack	Table 19
D - Constant Speed	35	Open Rack	Table 19
E - Idle-Acceleration	0-40	30 @ 30 mph	Table 20
F - Idle-Acceleration	0-40	40 @ 30 mph	Table 20

TABLE 19. CONSTANT SPEED DIESEL SMOKE EVALUATION PROCEDURE
(Variability Study)

Applicability:	GM Truck and Coach Model 4519 City Bus powered by Detroit Diesel 6 V-71 engine
Measurement Method:	U. S. Public Health Service full-flow light extinction type smokemeter.
Warm-up:	A minimum of three runs should be conducted prior to smoke evaluation to assure the engine and system have reached operating temperature.
Vehicle Speeds and Loads:	The following are to be run with the transmission in the drive range under full inertia simulation, air conditioning "off".

Vehicle Speed, mph	Approx. Engine Speed, rpm	Power Load
20	900	Open Rack
25	1000	Open Rack
30	1200	Open Rack
35	1400	Open Rack

Procedure:

(1) Zero potentiometric recorder and 100% adjust smokemeter with engine "off" using 2 SCFM of purge air to collimating tubes.

(2) Start engine and accelerate through upshift and load vehicle back to 20 mph at open rack maximum horsepower. On those vehicles which tend to downshift at 20 mph constant speed, operate as near 20 mph as possible. After 30 seconds of stable operation, note the average maximum smokemeter reading.

(3) Release some load in the water brake dynamometer and allow vehicle speed to increase to 25 mph. After 30 seconds of stable operation, note the average maximum smokemeter reading.

(4) Using the procedure in (3), similarly operate at 30 and 35 mph.

(5) Repeat items (1) through (4) three times.

TABLE 20. IDLE-ACCELERATION DIESEL SMOKE EVALUATION PROCEDURE
(Variability Study)

Applicability:	GM Truck and Coach Model 4519 City Bus powered by Detroit Diesel 6V-71 engine
Measurement Method:	U. S. Public Health Service full-flow light extinction type smokemeter.
Warm-up:	A minimum of three runs should be conducted prior to smoke evaluation to assure the engine and system have reached operating temperature.
Inertia:	Full inertia simulation via SwRI system.
Vehicle Speed and Load:	Idle for 1 minute followed by full rack acceleration to 40 mph with inertia and initially impressed dynamometer load.
Procedure:	(1) Zero potentiometric recorder and 100% adjust smokemeter with engine "off" using 2 SCFM of purge air to collimating tubes. (2) Start engine and allow to idle for one minute. Note maximum smoke at start on recorder. (3) After one minute of idle, full rack accelerate to 40 mph against full bus inertia simulation and under the initially impressed load of 30 hp at 30 mph in the water brake type dynamometer. (4) Note the maximum smoke at the start of acceleration and at upshift. (5) Repeat steps (1) through (4) above three times. (6) Impress 40 hp at 30 mph in the water brake dynamometer and conduct steps (1) through (5) above. Some vehicles will not reach 40 mph with 40 hp impressed at 30 mph. Operate as far past 30 mph as reasonable and discontinue. Maximum smoke normally does not occur at these higher speeds.

TABLE 21. SERIES 1 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 676
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, % Maximum	Minimum	Average
A-Const. Speed	20	59	18.0	16.0	16.8
B-Const. Speed	25	69	16.0	14.0	14.9
C-Const. Speed	30	80	15.5	13.5	14.3
D-Const. Speed	35	90	13.0	11.5	12.0

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp		PHS Smokemeter Reading, % Start	Accel	Upshift
E-Idle-Accel	30 @ 30 mph	Max.	27.0	13.5	13.5
		Min.	19.5	9.5	13.0
		Average	23.3	11.0	13.3
F-Idle-Accel	40 @ 30 mph	Max.	25.0	15.5	14.5
		Min.	21.0	10.0	13.0
		Average	23.5	12.9	13.3

TABLE 22. SERIES 2 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 678
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, % Maximum	Minimum	Average
A-Const. Speed	20	60	16.0	13.0	14.0
B-Const. Speed	25	70	13.0	10.0	11.3
C-Const. Speed	30	80	13.0	10.0	11.4
D-Const. Speed	35	90	12.0	8.5	9.8

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp		PHS Smokemeter Reading, % Start	Accel	Upshift
E-Idle-Accel	30 @ 30 mph	Max.	17.0	10.5	12.5
		Min.	15.5	7.0	11.5
		Average	16.3	8.8	12.3
F-Idle-Accel	40 @ 30 mph	Max.	16.5	7.5	12.0
		Min.	15.0	6.0	11.0
		Average	15.6	6.9	11.8

TABLE 23. SERIES 3 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 677
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, % Maximum	Minimum	Average
A-Const. Speed	20	60	24.0	23.0	23.3
B-Const. Speed	25	75	21.0	19.5	20.1
C-Const. Speed	30	86	20.0	19.5	19.8
D-Const. Speed	35	95	12.5	12.0	12.4

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp		PHS Smokemeter Reading, % Start	Accel	Upshift
E-Idle-Accel	30 @ 30 mph	Max.	30.0	12.0	20.5
		Min.	15.0	9.0	19.0
		Average	20.0	9.9	19.8
F-Idle-Accel	40 @ 30 mph	Max.	21.0	9.5	20.0
		Min.	15.0	8.0	19.0
		Average	18.3	8.6	19.0

TABLE 24. SERIES 4 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 680
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, % Maximum	Minimum	Average
A-Const. Speed	20	60	19.0	19.0	19.0
B-Const. Speed	25	71	18.0	17.0	17.6
C-Const. Speed	30	81	17.0	16.0	16.5
D-Const. Speed	35	95	13.0	11.0	12.1

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp		PHS Smokemeter Reading, % Start	Accel	Upshift
E-Idle-Accel	30 @ 30 mph	Max.	28.0	10.5	19.0
		Min.	21.0	8.0	17.5
		Average	24.5	9.5	18.1
F-Idle-Accel	40 @ 30 mph	Max.	27.0	10.0	18.5
		Min.	26.0	9.0	17.5
		Average	26.3	9.3	17.6

TABLE 25. SERIES 5 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 680
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, %		
			Maximum	Minimum	Average
A-Const. Speed	20	59	20.5	18.0	19.1
B-Const. Speed	25	71	16.5	15.0	13.3
C-Const. Speed	30	81	15.5	14.0	14.4
D-Const. Speed	35	94	13.5	10.0	12.1

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp	PHS Smokemeter Reading, %			
			Start	Accel	Upshift
E-Idle-Accel	30 @ 30 mph	Max.	28.0	8.0	13.0
		Min.	16.0	6.5	11.5
		Average	19.9	7.1	12.1
F-Idle-Accel	40 @ 30 mph	Max.	18.5	7.5	13.0
		Min.	16.5	6.0	11.0
		Average	16.8	6.9	12.1

TABLE 26. SERIES 6 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 682
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, % Maximum	Minimum	Average
A-Const. Speed	20	60	9.5	7.0	8.8
B-Const. Speed	25	74	7.0	5.5	6.3
C-Const. Speed	30	83	7.0	5.5	6.6
D-Const. Speed	35	94	6.0	3.0	5.1

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp		PHS Smokemeter Reading, % Start	Accel	Upshift
E-Idle-Accel	30 @ 30 mph	Max.	21.0	3.5	6.0
		Min.	16.0	2.5	4.5
		Average	18.0	3.0	5.3
F-Idle-Accel	40 @ 30 mph	Max.	39.0	3.0	5.5
		Min.	22.0	2.5	4.5
		Average	26.8	2.5	5.0

TABLE 27. SERIES 7 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 683
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, %		
			Maximum	Minimum	Average
A-Const. Speed	20	58	16.0	12.5	14.5
B-Const. Speed	25	71	10.5	8.0	9.3
C-Const. Speed	30	83	7.5	6.5	6.9
D-Const. Speed	35	98	6.5	6.0	6.0

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp	PHS Smokemeter Reading, %			
			Start	Accel	Upshift
E-Idle-Accel	30 @ 30 mph	Max.	25.0	6.0	8.0
		Min.	19.0	4.0	7.0
		Average	21.3	4.8	7.5
F-Idle-Accel	40 @ 30 mph	Max.	21.0	5.5	8.0
		Min.	19.0	3.5	7.0
		Average	19.8	4.1	7.5

TABLE 28. SERIES 8 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 684
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, % Maximum	Minimum	Average
A-Const. Speed	20	55	21.0	20.0	20.0
B-Const. Speed	25	70	17.0	15.0	16.1
C-Const. Speed	30	80	16.0	14.0	14.4
D-Const. Speed	35	90	12.0	11.5	11.8

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp		PHS Smokemeter Reading, % Start	Accel	Upshift
E-Idle-Accel	30 @ 30 mph	Max.	34.0	10.0	15.5
		Min.	27.0	7.0	13.5
		Average	30.9	8.5	13.9
F-Idle-Accel	40 @ 30 mph	Max.	33.0	8.5	14.5
		Min.	30.0	7.5	13.5
		Average	31.5	7.9	14.0

TABLE 29. SERIES 9 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 685
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, %		
			Maximum	Minimum	Average
A-Const. Speed	20	59	21.5	20.0	20.6
B-Const. Speed	25	79	17.5	14.0	15.4
C-Const. Speed	30	88	15.0	11.5	13.3
D-Const. Speed	35	98	12.0	9.0	10.9

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp	PHS Smokemeter Reading, %			
			Start	Accel	Upshift
E-Idle-Accel	30 @ 30 mph	Max.	30.0	10.0	15.5
		Min.	26.0	7.0	14.0
		Average	27.9	8.0	14.6
F-Idle-Accel	40 @ 30 mph	Max.	31.0	8.5	15.0
		Min.	26.0	8.0	14.5
		Average	29.3	8.0	14.6

TABLE 30. SERIES 10 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Bus 695
Inertia: Full Simulation

Operating Conditions: See Table 18
Fuel: Reference No. 1

Constant Speed Results

Type of Operation	Vehicle Speed, mph	Vehicle Load, Hp	PHS Smokemeter Reading, % Maximum	PHS Smokemeter Reading, % Minimum	PHS Smokemeter Reading, % Average
A-Const. Speed	20	55	16.0	15.0	15.5
B-Const. Speed	25	65	14.5	13.0	13.5
C-Const. Speed	30	70	15.0	13.5	14.5
D-Const. Speed	35	70	11.5	10.0	10.5

Idle-Acceleration Results

Type of Operation	Vehicle Load, Hp		PHS Smokemeter Reading, % Start	PHS Smokemeter Reading, % Accel	PHS Smokemeter Reading, % Upshift
E-Idle-Accel	30 @ 30 mph	Max.	36.0	10.0	13.5
		Min.	30.0	8.0	12.5
		Average	33.0	9.3	12.9
F-Idle-Accel	40 @ 30 mph	Max.	34.0	13.0	13.5
		Min.	30.0	8.0	13.0
		Average	33.0	11.0	13.0

TABLE 31. SUMMARY OF BUS VARIABILITY STUDY SMOKE EVALUATION RESULTS

Municipal Bus Series

Type of Operation	Vehicle Speed, mph	1	2	3	4	5	6	7	8	9	10	Overall Average
A - Constant Speed	20	16.8	14.0	23.3	19.0	19.1	8.8	14.5	20.0	20.6	15.5	17.2
B - Constant Speed	25	14.9	11.3	20.1	17.6	13.3	6.3	9.3	16.1	15.4	13.5	13.8
C - Constant Speed	30	14.3	11.4	19.8	16.5	14.4	6.6	6.9	14.4	13.3	14.5	13.2
D - Constant Speed	35	12.0	9.8	12.4	12.1	12.1	5.1	6.0	11.8	10.9	10.5	10.3
E - Idle-Accel (30 hp @ 30 mph)	Start	23.3	16.3	20.0	24.5	19.9	18.1	21.3	30.9	27.9	33.0	22.5
	Accel	11.0	8.8	9.9	9.5	7.1	3.0	4.8	8.5	8.0	9.3	8.0
	Upshift	13.3	12.3	19.8	18.1	12.1	5.3	7.5	13.9	14.6	12.9	13.0
F - Idle-Accel (40 hp @ 30 mph)	Start	23.5	15.6	18.3	26.3	16.8	26.8	19.8	31.5	29.3	33.0	24.1
	Accel	12.9	6.9	8.6	9.3	6.9	2.5	4.1	7.9	8.0	11.0	7.8
	Upshift	13.3	11.8	19.0	17.6	12.1	5.0	7.5	14.0	14.6	13.0	12.8

(1) All constant speed smoke measurements made at maximum power output in drive range.

All idle-acceleration smoke measurements made at open rack with full inertia simulation.

APPENDIX F

INTERCITY TRUCK-TRACTOR VARIABILITY RESULTS
(Cummins NH 220, Four-Cycle Engine)

TABLE 1. LIST OF TRUCK-TRACTORS EVALUATED DURING VEHICLE VARIABILITY STUDY

Series No.	Truck No. (Source)	Tractor Mfg.	Tractor Mileage	For Odor Results See Tables:	For Smoke Results See Table:
1	55958 (Ryder)	Ford	75952	8-8E	22
2	129 (ABC)	White	55811	9-9E	23
3	114 (ABC)	White	179365	10-10E	24
4	125 (ABC)	White	87770	11-11E	25
5	135 (ABC)	White	87760	12-12E	26
6	282 (Howell)	I. H.(1)	372, 827	13-13E	27
7	286 (Howell)	I. H.	159, 465	14-14E	28
8	284 (Howell)	I. H.	303, 501	15-15E	29
9	285 (Howell)	I. H.	343, 579	16-16E	30
10	283 (Howell)	I. H.	353, 210	17-17E	31

(1) International Harvester

TABLE 2. INTER-CITY TRUCK-TRACTOR VEHICLE VARIABILITY ODOR EVALUATION CONDITIONS

Vehicle Data:	Cab-over Inter-City tandem drive truck-tractor powered by 4 cycle Cummins NH-220 naturally aspirated diesel engine via Fuller RT9-10 Road-Ranger 10 Speed transmission and Eaton 4.1:1 single speed rear axles. Muffler under tractor or on stack at right rear corner of cab.
Sampling Data:	Constant sample flow at 700:1 dilution level.
Inertia:	32,000 lbs. vehicle weight per SwRI inertia simulation system (16,000 lbs. vehicle weight per each of two drive axles.)

OPERATING CONDITIONS

Type Operation	Engine Speed, rpm	Vehicle Load, Hp	Drive Gear	Vehicle Speed mph (approx.)	For Details, Refer to:
I Constant Speed	1700	150	7	26	Table 3
II Constant Speed	2100	150	7	33	Table 3
III Constant Speed - Idle	575	0	N	-	Table 4
IV Idle - Acceleration	575-2300	0	1	0-8	Table 5
V Acceleration	575-2200	60 hp at 2200 rpm 8th gear	9	43-53	Table 6
VI Constant Speed - Deceleration	2100-0	160 hp at 2100 rpm 9th gear	9	52-0	Table 7

TABLE 3: CONSTANT SPEED DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Variability Study)

Applicability: Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.

Sample Method: Constant sample flow at 700:1 dilution level.

Warm-up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.

Vehicle Speeds and Loads: The following are to be run under 32, 000 lbs. vehicle weight inertia simulation.

Vehicle Speed, mph	Drive Gear	Engine Speed, rpm	Vehicle Load, hp(1)	Power Level
26	7	1700	150	near maximum rack
33	7	2100	150	near maximum rack

Procedure:

(1) Operate at given stable engine and vehicle speed and load

(2) Turn "on" panel alert light and turn dilution system to "auto" control and continue stable operation.

(3) Ring bell for panel to begin odor evaluation 45 seconds after light is turned "ON" and maintain stable operation.

(4) Panel turns light "off" when evaluation is complete. The evaluation requires 50-70 seconds to complete.

Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with 2 to 3 exposures (sniffs) at will during the approximately 60 second period.

(5) When panel turns "off" light, turn dilution system to "man" control and decelerate.

(6) Wait 3 minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on.")

Run Time: Approximately 3 minutes; with 3 minute rest, 6 minutes.

TABLE 4. IDLE DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

Applicability: Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 2 speed rear axles.

Sample Method: Constant sample flow at 700:1 dilution level.

Warm-up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.

Vehicle Speed and Load: Engine idled at 575 rpm after one minute of operation in 8th gear at 37 mph, 150 hp and 1900 rpm engine speed.

Procedure:

(1) Operate vehicle in 8th gear at 37 mph, engine at 1900 rpm and producing 150 hp at rear wheels for one minute.

(2) After one minute of stable operation, closed rack decelerate to 30 mph and shift to neutral and allow engine to idle.

(3) Turn "on" panel alert light and turn dilution system to "auto" when vehicle is shifted to neutral and engine is permitted to idle at 575 rpm.

(4) Ring bell for panel exposure 30 seconds after beginning of engine idle and continue idle.

(5) Panel turns light "off" when evaluation is complete. The evaluations require 50-70 seconds to complete.

Note: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with 2 to 3 exposures (sniffs) at will during the approximately 60 second period.

(6) When panel turns "off" light, turn dilution system to "man" control.

(7) Wait 3 minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on".)

Run Time: Approximately 3 minutes, with 3 minute rest, 6 minutes.

TABLE 5. IDLE-ACCELERATION DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Variability Study)

Applicability:	Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.
Sample Method:	Constant sample flow at 700:1 dilution level.
Warm-Up:	A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.
Inertia Simulation:	32, 000 lbs. vehicle weight via SwRI System
Vehicle Speed and Load:	Engine idle at 575 rpm followed by normal acceleration from 0 mph to 8 mph in 1st gear with 0 horsepower impressed in water brake dynamometer.
Procedure:	(1) Turn "on" panel alert light, start engine and idle and turn dilution system to "auto". (2) After one minute of idle, 575 rpm engine speed, accelerate in 1st gear. (Inertia simulation of 32, 000 lbs. vehicle weight; 16, 000 lbs. per each of two drive axles.) Power is applied gradually essentially as in normal truck operation. (3) Ring bell as engine speed crosses 1500 rpm on chart recorder (approximately 3 seconds after start of acceleration) for panel exposure. (4) Continue to accelerate to maximum engine and vehicle speed in 1st gear (2300 rpm and 8 mph), hold for 15 seconds, then shift to neutral and turn "off" engine. Turn "off" light. (5) Repeat items (1) - (4) above after 2 minute rest. The original and repeat idle-acceleration constitute one run. (6) Wait 3 minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on".)

NOTE: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualitites with an original and a repeat exposure (sniff).

Run Time: Approximately 4-1/2 minutes; with 3 minute rest, 7-1/2 minutes

TABLE 6. ACCELERATION DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Variability Study)

Applicability: Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.

Sample Method: Constant sample flow at 700:1 dilution level.

Warm-up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.

Inertia Simulation: 32,000 lbs. vehicle weight via SwRI system.

Vehicle Speed and Load: Full rack acceleration from 43 to 53 mph in 9th gear with 60 hp initially impressed in water brake dynamometer and retained.

Procedure:

(1) Operate in 8th gear at 2200 rpm engine speed, 43 mph, and impress 60 hp into dynamometer.

(2) Turn "on" panel alert light and turn dilution system to "auto" control.

(3) After 30 seconds of stable operation in 8th gear at 60 hp, upshift to 9th gear and full rack accelerate to 53 mph, load retained in dynamometer.

(4) Ring bell for panel exposure on reaching 2100 rpm.

(5) Continue to accelerate in 9th gear to 53 mph, 2200 rpm engine speed, and hold for 15 seconds.

(6) Turn "off" light and turn dilution system to "man" and decelerate to a holding condition in 8th gear.

(7) Repeat items (1) - (5) above after 2 minute rest. The original and repeat constitute one run.

(8) Wait 3 minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on".)

NOTE: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with an original and a repeat exposure (sniff).

Run Time: Approximately 5 minutes; with 3 minute rest, 8 minutes

TABLE 7. CONSTANT SPEED-DECELERATION DIESEL ODOR QUALITY/INTENSITY EVALUATION PROCEDURE

(Variability Study)

Applicability: Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.

Sample Method: Constant sample flow at 700:1 dilution level.

Warm-up: A minimum of three runs should be conducted prior to odor evaluation to assure the engine and drive line systems have reached operating temperature.

Inertia Simulation: 32,000 lbs. vehicle weight via SwRI system.

Vehicle Speed and Load: Operate in 9th gear at 2100 rpm engine speed, 52 mph vehicle speed, at open rack, 160 hp, for 1 minute followed by closed rack deceleration with load retained in water brake dynamometer.

Procedure:

(1) Operate in 9th gear at 2100 rpm engine speed and 52 mph vehicle speed at open rack, 160 hp.

(2) Turn "on" panel alert light and turn dilution system to "auto" control.

(3) Continue to operate at stable constant speed conditions for 1 minute and then closed rack decelerate with load retained in water brake dynamometer.

(4) Ring bell for panel exposure 5 seconds after start of closed rack deceleration.

(5) Continue deceleration another 10 seconds and then turn "off" light and turn dilution system to "man" control.

(6) Wait two minutes and repeat items (1) - (6) above. The original and repeat constitute one run.

(7) Wait three minutes between runs for panel rest and orifice change. (Time starts when light is turned "off" and should end when light is turned back "on".)

NOTE: The panel evaluates the dilute diesel exhaust sample for the overall diesel composite and each of the four qualities with an original and a repeat exposure (sniff).

Run Time: Approximately 6 minutes; with 3 minute rest, 8 minutes.

TABLE 8. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 55958
Date: January 19, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 1.	Const. Speed	3.8	1.0	0.6	0.8	0.1
8.	" "	3.2	0.6	0.8	0.8	0.1
16.	" "	3.2	0.6	0.7	0.8	0.1
22.	" "	1.6	0.5	0.5	0.2	0.1
		3.0	0.7	0.8	0.7	0.1
II. 4.	Const. Speed	3.1	0.4	0.7	0.6	0.1
12.	" "	2.8	0.5	0.7	1.0	0
18.	" "	3.9	0.7	0.8	0.9	0.1
26.	" "	2.8	0.8	0.7	0.6	0.2
		3.1	0.6	0.7	0.8	0.1
III. 3.	Idle	5.1	1.1	1.2	1.5	0.2
9.	"	4.0	0.8	1.0	0.6	0.4
14.	"	2.3	0.5	0.5	0.6	0
25.	"	5.2	1.2	1.0	1.0	0.6
		4.2	0.9	0.9	0.9	0.4
IV. 2.	Idle - Accel	5.2	1.5	1.2	0.9	0
7.	" "	4.9	1.2	0.9	1.0	0.4
17.	" "	3.1	0.4	0.9	1.5	0
27.	" "	2.4	0.4	0.9	0.5	0
		3.9	0.9	1.0	1.0	0.1
V. 5.	Accel	2.9	0.5	0.8	0.7	0.1
11.	"	3.8	0.8	1.0	0.6	0
19.	"	3.7	0.8	0.9	0.8	0
23.	"	3.4	0.8	0.8	0.8	0
		3.5	0.7	0.9	0.7	0
VI. 6.	Decel	5.9	1.7	1.1	1.1	0.2
13.	"	6.5	1.7	1.6	0.8	0.6
15.	"	4.6	1.0	0.9	0.9	0
21.	"	4.5	1.0	0.9	1.1	0.4
		5.4	1.4	1.1	1.0	0.4

(1) Runs 10, 20, 24 and 28 were conducted without exhaust sample.

TABLE 8A. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Diesel Composite Standard)

Vehicle: Tractor 55958
Date: January 19, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"D" Composite Responses 0	1	2	3	4	5	6	7	Average
1.	Const. Speed			1	1	7	1			3.8
2.	Idle-Accel				1	1	3	5		5.2
3.	Idle				1		6	3		5.1
4.	Const. Speed	2		1		6	1			3.1
5.	Accel			2	7	1				2.9
6.	Decel						1	9		5.9
7.	Idle-Accel					1	9			4.9
8.	Const. Speed			1	6	3				3.2
9.	Idle				3	4	3			4.0
10.	Blank	6		2	2					1.0
11.	Accel			1		9				3.8
12.	Const. Speed			3	6	1				2.8
13.	Decel						2	1	7	6.5
14.	Idle	5	1		1			2	1	2.3
15.	Decel					4	6			4.6
16.	Const. Speed				8	2				3.2
17.	Idle-Accel			3	3	4				3.1
18.	Const. Speed				3	5	2			3.9
19.	Accel				6	1	3			3.7
20.	Idle	2	1	2	1	1	2	1		2.8
21.	Decel					5	5			4.5
22.	Const. Speed	4		3	2	1				1.6
23.	Accel			1	4	5				3.4
24.	Blank	9	1							0.1
25.	Idle				1		5	4		5.2
26.	Const. Speed	2			4	4				2.8
27.	Idle-Accel			7	2	1				2.4
28.	Blank				3	4	3			4.0

(1) Runs 10, 20, 24 and 28 were conducted without exhaust sample.

TABLE 8B. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Tractor 55958
Date: January 19, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	Average
1.	Const. Speed		10		1.0
2.	Idle-Accel		5	5	1.5
3.	Idle	2	5	3	1.1
4.	Const. Speed	6	4		0.4
5.	Accel	5	5		0.5
6.	Decel	1	1	8	1.7
7.	Idle-Accel		8	2	1.2
8.	Const. Speed	4	6		0.6
9.	Idle	3	6	1	0.8
10.	Blank	7	3		0.3
11.	Accel	3	6	1	0.8
12.	Const. Speed	5	5		0.5
13.	Decel	1	1	8	1.7
14.	Idle	7	1	2	0.5
15.	Decel	1	8	1	1.0
16.	Const. Speed	4	6		0.6
17.	Idle-Accel	6	4		0.4
18.	Const. Speed	3	7		0.7
19.	Accel	2	8		0.8
20.	Idle	5	4	1	0.6
21.	Decel	1	8	1	1.0
22.	Const. Speed	5	5		0.5
23.	Accel	2	8		0.8
24.	Blank	10			0
25.	Idle	1	6	3	1.2
26.	Const. Speed	3	6	1	0.8
27.	Idle-Accel	6	4		0.4
28.	Blank	4	6		0.6

(1) Runs 10, 20, 24 and 28 were conducted without exhaust sample.

TABLE 8C. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Tractor 55958
Date: January 19, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	Average
1.	Const. Speed	4	6		0.6
2.	Idle-Accel	1	6	3	1.2
3.	Idle	1	6	3	1.2
4.	Const. Speed	3	7		0.7
5.	Accel	3	6	1	0.8
6.	Decel	1	7	2	1.1
7.	Idle-Accel	1	9		0.9
8.	Const. Speed	2	8		0.8
9.	Idle		10		1.0
10.	Blank	6	4		0.4
11.	Accel		10		1.0
12.	Const. Speed	3	7		0.7
13.	Decel		4	6	1.6
14.	Idle	6	3	1	0.5
15.	Decel	2	7	1	0.9
16.	Const. Speed	3	7		0.7
17.	Idle-Accel	1	9		0.9
18.	Const. Speed	3	6	1	0.8
19.	Accel	2	7	1	0.9
20.	Idle	5	5		0.5
21.	Decel	1	9		0.9
22.	Const. Speed	5	5		0.5
23.	Accel	2	8		0.8
24.	Blank	9	1		0.1
25.	Idle		10		1.0
26.	Const. Speed	3	7		0.7
27.	Idle-Accel	1	9		0.9
28.	Blank		8	2	1.2

(1) Runs 10, 20, 24 and 28 were conducted without exhaust sample.

TABLE 8D. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 55958
Date: January 19, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	Average
1.	Const. Speed	2	8		0.8
2.	Idle-Accel	2	7	1	0.9
3.	Idle		5	5	1.5
4.	Const. Speed	4	6		0.6
5.	Accel	3	7		0.7
6.	Decel		9	1	1.1
7.	Idle-Accel	1	8	1	1.0
8.	Const. Speed	3	6	1	0.8
9.	Idle	6	2	2	0.6
10.	Blank	8	1	1	0.3
11.	Accel	4	6		0.6
12.	Const. Speed	1	8	1	1.0
13.	Decel	4	4	2	0.8
14.	Idle	6	2	2	0.6
15.	Decel	2	7	1	0.9
16.	Const. Speed	4	4	2	0.8
17.	Idle-Accel		5	5	1.5
18.	Const. Speed	2	7	1	0.9
19.	Accel	3	6	1	0.8
20.	Idle	6	3	1	0.5
21.	Decel		9	1	1.1
22.	Const. Speed	8	2		0.2
23.	Accel	2	8		0.8
24.	Blank	10			0
25.	Idle	1	8	1	1.0
26.	Const. Speed	4	6		0.6
27.	Idle-Accel	5	5		0.5
28.	Blank	1	7	2	1.1

(1) Runs 10, 20, 24 and 28 were conducted without exhaust sample.

TABLE 8E. SERIES 1 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Tractor 55958
Date: January 19, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	2	Average
1.	Const. Speed	9	1		0.1
2.	Idle Accel	10			0
3.	Idle	9		1	0.2
4.	Const. Speed	9	1		0.1
5.	Accel	9	1		0.1
6.	Decel	8	2		0.2
7.	Idle Accel	6	4		0.4
8.	Const. Speed	9	1		0.1
9.	Idle	6	4		0.4
10.	Blank	10			0
11.	Accel	10			0
12.	Const. Speed	10			0
13.	Decel	5	4	1	0.6
14.	Idle	10			0
15.	Decel	9	1		0.1
16.	Const. Speed	9	1		0.1
17.	Idle Accel	10			0
18.	Const. Speed	9	1		0.1
19.	Accel	10			0
20.	Idle	9	1		0.1
21.	Decel	6	4		0.4
22.	Const. Speed	9	1		0.1
23.	Accel	10			0
24.	Blank	10			0
25.	Idle	4	6		0.6
26.	Const. Speed	8	2		0.2
27.	Idle-Accel	10			0
28.	Blank	8	2		0.2

(1) Runs 10, 20, 24 and 28 were conducted without exhaust sample.

Table 9. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 129
Date: January 24, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)		Operating Condition	Average Panel Responses				
			"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I.	5.	Const. Speed	2.9	0.7	0.6	0.6	0.3
	[illegible]	" "	3.1	1.1	0.6	0.6	0.2
	15.	" "	2.7	0.6	0.8	0.5	0.2
	28	" "	2.4	0.7	0.7	0.6	0
			2.8	0.8	0.7	0.6	0.2
II.	2.	Const. Speed	1.7	0.6	0.7	0	0
	12.	" "	3.0	0.6	0.9	0.5	0.2
	21.	" "	3.6	0.9	0.6	0.9	0.4
	23.	" "	2.4	0.8	0.6	0.6	0.1
			2.7	0.7	0.7	0.5	0.2
III.	7.	Idle	3.0	0.7	0.7	0.5	0.2
	11.	"	2.9	0.7	0.6	0.8	0
	18.	"	4.8	1.3	0.9	1.1	0.7
	25.	"	4.3	0.9	0.9	1.3	0.3
			3.8	0.9	0.8	0.9	0.3
IV.	4.	Idle - Accel	3.6	0.8	0.8	0.7	0.6
	14.	" "	1.8	0.5	0.8	0.4	0
	20.	" "	3.9	1.0	0.8	0.9	0.4
	27.	" "	2.2	0.7	0.6	0.5	0
			2.9	0.8	0.8	0.6	0.3
V.	10.	Accel	2.2	0.8	0.7	0.4	0.1
	16.	"	2.5	0.6	0.8	0.6	0
	19.	"	2.8	0.6	0.8	0.6	0.3
	22.	"	1.9	0.5	0.7	0.5	0.1
			2.4	0.6	0.8	0.5	0.1
VI.	1.	Decel	4.4	1.0	1.1	0.7	0.2
	6.	"	4.6	1.0	0.8	0.7	0.5
	13.	"	3.2	1.0	0.9	0.7	0.2
	24.	"	4.7	1.2	1.1	1.1	0.5
			4.2	1.1	1.0	0.8	0.4

(1) Runs 3, 9, 17 and 26 were conducted without exhaust sample.

TABLE 9A. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Diesel Composite Standard)

Vehicle: Tractor 129
Date: January 24, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"D" Composite Responses 0	1	2	3	4	5	Average
1.	Decel				1	4	5	4.4
2.	Const. Speed		4	5	1			1.7
3.	Blank	1	1	4	3	1		2.2
4.	Idle-Accel			2		8		3.6
5.	Const. Speed		2		5	3		2.9
6.	Decel					4	6	4.6
7.	Idle			4	2	4		3.0
8.	Const. Speed		1	3		6		3.1
9.	Blank			4	6			2.6
10.	Accel			8	2			2.2
11.	Idle			4	3	3		2.9
12.	Const. Speed				10			3.0
13.	Decel				8	2		3.2
14.	Idle-Accel		2	8				1.8
15.	Const. Speed			4	5	1		2.7
16.	Accel			7	1	2		2.5
17.	Blank		2	4	4			2.2
18.	Idle					2	8	4.8
19.	Accel			4	4	2		2.8
20.	Idle-Accel				3	5	2	3.9
21.	Const. Speed			1	2	7		3.6
22.	Accel		5	1	4			1.9
23.	Const. Speed			6	4			2.4
24.	Decel					3	7	4.7
25.	Idle					7	3	4.3
26.	Blank				5	5		3.5
27.	Idle-Accel			8	2			2.2
28.	Const. Speed	1	1	1	7			2.4

(1) Runs 3, 9, 17 and 26 were conducted without exhaust sample.

TABLE 9B. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Tractor 129
Date: January 24, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	Average
1.	Decel		10		1.0
2.	Const. Speed	4	6		0.6
3.	Blank	4	6		0.6
4.	Idle-Accel	2	8		0.8
5.	Const. Speed	3	7		0.7
6.	Decel	1	8	1	1.0
7.	Idle	3	7		0.7
8.	Const. Speed	1	7	2	1.1
9.	Blank	2	7	1	0.9
10.	Accel	3	6	1	0.8
11.	Idle	3	7		0.7
12.	Const. Speed	4	6		0.6
13.	Decel	1	8	1	1.0
14.	Idle-Accel	5	5		0.5
15.	Const. Speed	4	6		0.6
16.	Accel	4	6		0.6
17.	Blank	6	4		0.4
18.	Idle	1	5	4	1.3
19.	Accel	4	6		0.6
20.	Idle-Accel	1	8	1	1.0
21.	Const. Speed	1	9		0.9
22.	Accel	5	5		0.5
23.	Const. Speed	2	8		0.8
24.	Decel		8	2	1.2
25.	Idle	2	7	1	0.9
26.	Blank	4	5	1	0.7
27.	Idle-Accel	3	7		0.7
28.	Const. Speed	3	7		0.7

(1) Runs 3, 9, 17 and 26 were conducted without exhaust sample.

TABLE 9C. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Tractor 129
Date: January 24, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	Average
1.	Decel	2	5	3	1.1
2.	Const. Speed	3	7		0.7
3.	Blank	4	5	1	0.7
4.	Idle-Accel	2	8		0.8
5.	Const. Speed	4	6		0.6
6.	Decel	3	6	1	0.8
7.	Idle	3	7		0.7
8.	Const. Speed	4	6		0.6
9.	Blank	4	6		0.6
10.	Accel	3	7		0.7
11.	Idle	4	6		0.6
12.	Const. Speed	2	7	1	0.9
13.	Decel	1	9		0.9
14.	Idle-Accel	2	8		0.8
15.	Const. Speed	2	8		0.8
16.	Accel	2	8		0.8
17.	Blank	2	8		0.8
18.	Idle	1	9		0.9
19.	Accel	2	8		0.8
20.	Idle-Accel	2	8		0.8
21.	Const. Speed	4	6		0.6
22.	Accel	3	7		0.7
23.	Const. Speed	4	6		0.6
24.	Decel		9	1	1.1
25.	Idle	1	9		0.9
26.	Blank	3	7		0.7
27.	Idle-Accel	4	6		0.6
28.	Const. Speed	3	7		0.7

(1) Runs 3, 9, 17 and 26 were conducted without exhaust sample.

TABLE 9D. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 129
Date: January 24, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	Average
1.	Decel	4	5	1	0.7
2.	Const. Speed	10			0
3.	Blank	9	1		0.1
4.	Idle-Accel	3	7		0.7
5.	Const. Speed	5	4	1	0.6
6.	Decel	3	7		0.7
7.	Idle	5	5		0.5
8.	Const. Speed	4	6		0.6
9.	Blank	4	6		0.6
10.	Accel	6	4		0.4
11.	Idle	3	6	1	0.8
12.	Const. Speed	5	5		0.5
13.	Decel	4	5	1	0.7
14.	Idle-Accel	6	4		0.4
15.	Const. Speed	5	5		0.5
16.	Accel	4	6		0.6
17.	Blank	8	2		0.2
18.	Idle		9	1	1.1
19.	Accel	4	6		0.6
20.	Idle-Accel	1	9		0.9
21.	Const. Speed	2	7	1	0.9
22.	Accel	5	5		0.5
23.	Const. Speed	4	6		0.6
24.	Decel	1	7	2	1.1
25.	Idle		7	3	1.3
26.	Blank	1	8	1	1.0
27.	Idle-Accel	5	5		0.5
28.	Const. Speed	4	6		0.6

(1) Runs 3, 9, 17 and 26 were conducted without exhaust sample.

TABLE 9E. SERIES 2 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Tractor 129
Date: January 24, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	Average
1.	Decel	8	2	0.2
2.	Const. Speed	10		0
3.	Blank	10		0
4.	Idle-Accel	4	6	0.6
5.	Const. Speed	7	3	0.3
6.	Decel	5	5	0.5
7.	Idle	8	2	0.2
8.	Const. Speed	8	2	0.2
9.	Blank	8	2	0.2
10.	Accel	9	1	0.1
11.	Idle	10		0
12.	Const. Speed	8	2	0.2
13.	Decel	8	2	0.2
14.	Idle-Accel	10		0
15.	Const. Speed	8	2	0.2
16.	Accel	10		0
17.	Blank	10		0
18.	Idle	3	7	0.7
19.	Accel	7	3	0.3
20.	Idle-Accel	6	4	0.4
21.	Const. Speed	6	4	0.4
22.	Accel	9	1	0.1
23.	Const. Speed	9	1	0.1
24.	Decel	5	5	0.5
25.	Idle	7	3	0.3
26.	Blank	8	2	0.2
27.	Idle-Accel	10		0
28.	Const. Speed	10		0

(1) Runs 3, 9, 17 and 26 were conducted without exhaust sample.

TABLE 10. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 114
Date: January 25, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

			Average Panel Responses				
Run	No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I.	3.	Const. Speed	3.3	1.0	0.8	0.6	0
	8.	" "	4.0	0.9	0.9	1.2	0
	12.	" "	2.8	0.5	0.6	0.8	0.2
	25.	" "	3.0	0.6	1.0	1.0	0.1
			3.3	0.8	0.8	0.9	0.1
II.	1.	Const. Speed	2.9	0.7	1.0	0.5	0
	16.	" "	1.2	0.1	0.5	0.5	0
	20.	" "	2.1	0.5	0.9	0.8	0
	27.	" "	1.8	0.1	0.9	0.3	0
			2.0	0.4	0.8	0.5	0
III.	2.	Idle	4.1	0.9	1.0	1.0	0.4
	10.	"	4.7	1.3	0.8	0.8	0.3
	17.	"	2.8	0.5	0.8	1.1	0.1
	28.	"	4.8	1.1	1.0	1.0	0.5
			4.1	1.0	0.9	1.0	0.3
IV.	9.	Idle - Accel	5.0	1.3	1.2	1.1	0.3
	15.	" "	3.1	0.8	0.7	1.0	0.1
	21.	" "	3.7	1.0	1.1	0.8	0.4
	26.	" "	4.1	1.1	1.0	0.8	0.1
			4.1	1.1	1.0	0.9	0.2
V.	4.	Accel	3.0	1.0	0.8	0.8	0.1
	7.	"	4.8	1.1	0.9	1.0	0
	13.	"	3.1	1.0	0.7	0.8	0.1
	24.	"	3.6	0.6	0.9	0.8	0.4
			3.9	0.9	0.8	0.9	0.2
VI.	5.	Decel	5.6	1.4	1.4	1.1	0.6
	11.	"	4.7	1.4	1.1	0.8	0.3
	19.	"	5.2	1.3	1.3	1.3	0.7
	22.	"	5.6	1.8	1.2	1.1	1.0
			5.3	1.5	1.3	1.1	0.6

(1) Runs 6, 14, 18 and 23 were conducted without exhaust sample.

TABLE 10A. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Diesel Composite Standard)

Vehicle: Tractor 114
Date: January 25, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"D" Composite Responses								
		0	1	2	3	4	5	6	7	Average
1.	Const. Speed			4	3	3				2.9
2.	Idle				1	7	2			4.1
3.	Const. Speed				7	3				3.3
4.	Accel			2	6	2				3.0
5.	Decel						4	6		5.6
6.	Blank	7	2	1						0.4
7.	Accel					2	8			4.8
8.	Const. Speed				1	8	1			4.0
9.	Idle-Accel					3	4	3		5.0
10.	Idle					4	5	1		4.7
11.	Decel					3	7			4.7
12.	Const. Speed		2		6	2				2.8
13.	Accel			1	7	2				3.1
14.	Blank	4	2	4						1.0
15.	Idle-Accel			1	7	2				3.1
16.	Const. Speed	2	4	4						1.2
17.	Idle			2	8					2.8
18.	Blank	7	2	1						0.4
19.	Decel						8	2		5.2
20.	Const. Speed			9	1					2.1
21.	Idle-Accel			1	4	3	1	1		3.7
22.	Decel					1	2	7		5.6
23.	Blank	9		1						0.2
24.	Accel				4	6				3.6
25.	Const. Speed			2	7		1			3.0
26.	Idle-Accel				1	7	2			4.1
27.	Const. Speed		4	4	2					1.8
28.	Idle					3	6	1		4.8

(1) Runs 6, 4, 18 and 23 were conducted without exhaust sample.

TABLE 10B. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Tractor 114
Date: January 25, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	Average
1.	Const. Speed	3	7		0.7
2.	Idle	2	7	1	0.9
3.	Const. Speed		10		1.0
4.	Accel		10		1.0
5.	Decel		6	4	1.4
6.	Blank	9	1		0.1
7.	Accel	2	5	3	1.1
8.	Const. Speed	2	7	1	0.9
9.	Idle-Accel		7	3	1.3
10.	Idle		7	3	1.3
11.	Decel		6	4	1.4
12.	Const. Speed	5	5		0.5
13.	Accel		10		1.0
14.	Blank	9	1		0.1
15.	Idle-Accel	2	8		0.8
16.	Const. Speed	9	1		0.1
17.	Idle	5	5		0.5
18.	Blank	9	1		0.1
19.	Decel	1	5	4	1.3
20.	Const. Speed	5	5		0.5
21.	Idle-Accel	1	8	1	1.0
22.	Decel		2	8	1.8
23.	Blank	10			0
24.	Accel	1	8	1	1.0
25.	Const. Speed	4	6		0.6
26.	Idle-Accel	1	7	2	1.1
27.	Const. Speed	9	1		0.1
28.	Idle	1	7	2	1.1

(1) Runs 6, 14, 18 and 23 were conducted without exhaust sample.

TABLE 10C. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Tractor 114
Date: January 25, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses			
		0	1	2	Average
1.	Const. Speed	1	8	1	1.0
2.	Idle	1	8	1	1.0
3.	Const. Speed	3	6	1	0.8
4.	Accel	2	8		0.8
5.	Decel		6	4	1.4
6.	Blank	9	1		0.1
7.	Accel	1	9		0.9
8.	Const. Speed	1	9		0.9
9.	Idle-Accel	1	6	3	1.2
10.	Idle	2	8		0.8
11.	Decel	1	7	2	1.1
12.	Const. Speed	4	6		0.6
13.	Accel	3	7		0.7
14.	Blank	7	3		0.3
15.	Idle-Accel	3	7		0.7
16.	Const. Speed	5	5		0.5
17.	Idle	2	8		0.8
18.	Blank	9	1		0.1
19.	Decel		7	3	1.3
20.	Const. Speed	1	9		0.9
21.	Idle-Accel		9	1	1.1
22.	Decel		8	2	1.2
23.	Blank	9	1		0.1
24.	Accel	1	9		0.9
25.	Const. Speed		10		1.0
26.	Idle-Accel	1	8	1	1.0
27.	Const. Speed	1	9		0.9
28.	Idle	1	8	1	1.0

(1) Runs 6, 14, 18 and 23 were conducted without exhaust sample.

TABLE 10D. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 114
Date: January 25, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	3	Average
1.	Const. Speed	5	5			0.5
2.	Idle	3	5	1	1	1.0
3.	Const. Speed	4	6			0.6
4.	Accel	3	6	1		0.8
5.	Decel	1	7	2		1.1
6.	Blank	10				0
7.	Accel	1	8	1		1.0
8.	Const. Speed		8	2		1.2
9.	Idle-Accel	1	8		1	1.1
10.	Idle	3	6	1		0.8
11.	Decel	3	6	1		0.8
12.	Const. Speed	4	4	2		0.8
13.	Accel	3	6	1		0.8
14.	Blank	5	5			0.5
15.	Idle-Accel	1	8	1		1.0
16.	Const. Speed	6	3	1		0.5
17.	Idle		9	1		1.1
18.	Blank	9	1			0.1
19.	Decel		7	3		1.3
20.	Const. Speed	2	8			0.8
21.	Idle-Accel	3	6	1		0.8
22.	Decel	2	6	1	1	1.1
23.	Blank	9	1			0.1
24.	Accel	2	8			0.8
25.	Const. Speed	3	4	3		1.0
26.	Idle-Accel	3	6	1		0.8
27.	Const. Speed	7	3			0.3
28.	Idle	1	8	1		1.0

(1) Runs 6, 14, 18 and 23 were conducted without exhaust sample.

TABLE 10E. SERIES 3 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Truck 114	Operating Conditions: See Table 3
Date: January 25, 1967	Fuel: Reference No. 2

Run No. (1)	Operating Condition	"P" Pungent Responses			
		0	1	2	Average
1.	Const. Speed	10			0
2.	Idle	6	4		0.4
3.	Const. Speed	10			0
4.	Accel	9	1		0.1
5.	Decel	4	6		0.6
6.	Blank	10			0
7.	Accel	10			0
8.	Const. Speed	10			0
9.	Idle-Accel	7	3		0.3
10.	Idle	7	3		0.3
11.	Decel	7	3		0.3
12.	Const. Speed	8	2		0.2
13.	Accel	9	1		0.1
14.	Blank	10			0
15.	Idle-Accel	9	1		0.1
16.	Const. Speed	10			0
17.	Idle	9	1		0.1
18.	Blank	10			0
19.	Decel	3	7		0.7
20.	Const. Speed	10			0
21.	Idle-Accel	6	4		0.4
22.	Decel	3	4	3	1.0
23.	Blank	10			0
24.	Accel	6	4		0.4
25.	Const. Speed	9	1		0.1
26.	Idle-Accel	9	1		0.1
27.	Const. Speed	10			0
28.	Idle	5	5		0.5

(1) Runs 8, 14, 18 and 23 were conducted without exhaust sample.

TABLE 11. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 125
Date: January 26, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 2.	Const. Speed	1.3	0.2	0.7	0	0
12.	" "	0.1	0	0	0	0
16.	" "	1.8	0.2	0.6	0.7	0.1
25.	" "	2.7	0.6	1.0	1.0	0
		1.5	0.3	0.6	0.4	0
II. 5.	Const. Speed	2.2	0.7	0.9	0.4	0
10.	" "	2.4	0.5	0.5	0.6	0.1
20.	" "	2.2	0.6	1.1	0.6	0.2
28.	" "	1.6	0.4	0.8	0.6	0
		2.1	0.6	0.8	0.6	0.1
III. 3.	Idle	4.1	1.1	1.0	0.9	0.1
7.	"	4.5	1.1	1.1	1.0	0.6
17.	"	3.4	0.8	0.8	0.9	0.3
26.	"	4.8	1.3	1.1	1.1	0.7
		4.2	1.1	1.0	1.0	0.4
IV. 8.	Idle - Accel	2.6	0.7	0.8	1.0	0.1
9.	" "	4.1	1.0	1.1	0.8	0.3
15.	" "	3.5	0.6	0.9	1.1	0
19.	" "	1.7	0.4	0.8	0.4	0.4
		3.0	0.7	0.9	0.8	0.2
V. 4.	Accel	2.5	0.6	0.7	0.6	0
13.	"	4.1	1.1	0.9	1.0	0.3
21.	"	3.2	0.8	1.1	0.6	0.1
23.	"	3.3	0.8	1.0	0.8	0.2
		3.3	0.8	0.9	0.8	0.2
VI. 6.	Decel	4.5	1.0	1.4	1.1	0.1
11.	"	4.8	1.3	1.2	1.1	0.8
18.	"	4.4	0.8	0.9	1.5	0.7
22.	"	4.9	1.1	1.0	0.7	0.7
		4.7	1.1	1.1	1.1	0.6

(1) Runs 1, 14, 24 and 27 were conducted without exhaust sample.

TABLE 11A. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Diesel Composite Standard)

Vehicle: Tractor 125
Date: January 26, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"D" Composite Responses							
		0	1	2	3	4	5	6	Average
1.	Blank		9	1					1.1
2.	Const. Speed	1	5	4					1.3
3.	Idle					9	1		4.1
4.	Accel			5	5				2.5
5.	Const. Speed			8	2				2.2
6.	Decel				1	3	6		4.5
7.	Idle					5	5		4.5
8.	Idle-Accel			4	6				2.6
9.	Idle-Accel				1	7	2		4.1
10.	Const. Speed	1		4	4	1			2.4
11.	Decel					2	8		4.8
12.	Const. Speed	9	1						0.1
13.	Accel				1	7	2		4.1
14.	Blank			2	6	2			3.0
15.	Idle-Accel				5	5			3.5
16.	Const. Speed	3		3	4				1.8
17.	Idle			2	3	4	1		3.4
18.	Decel				1	4	5		4.4
19.	Idle-Accel		3	7					1.7
20.	Const. Speed		3	5		1	1		2.2
21.	Accel			1	6	3			3.2
22.	Decel					1	9		4.9
23.	Accel			2	3	5			3.3
24.	Blank	8	2						0.2
25.	Const. Speed			3	7				2.7
26.	Idle					3	6	1	4.8
27.	Blank	8	2						0.2
28.	Const. Speed		4	6					1.6

(1) Runs 1, 14, 24 and 27 were conducted without exhaust sample.

TABLE 11B. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Tractor 125
Date: January 26, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	Average
1.	Blank	8	2		0.2
2.	Const. Speed	8	2		0.2
3.	Idle		9	1	1.1
4.	Accel	4	6		0.6
5.	Const. Speed	3	7		0.7
6.	Decel		10		1.0
7.	Idle	1	7	2	1.1
8.	Idle-Accel	3	7		0.7
9.	Idle-Accel		10		1.0
10.	Const. Speed	5	5		0.5
11.	Decel	1	5	4	1.3
12.	Const. Speed	10			0
13.	Accel		9	1	1.1
14.	Blank	3	7		0.7
15.	Idle-Accel	4	6		0.6
16.	Const. Speed	8	2		0.2
17.	Idle	2	8		0.8
18.	Decel	2	8		0.8
19.	Idle-Accel	6	4		0.4
20.	Const. Speed	4	6		0.6
21.	Accel	2	8		0.8
22.	Decel	1	7	2	1.1
23.	Accel	2	8		0.8
24.	Blank	10			0
25.	Const. Speed	4	6		0.6
26.	Idle	1	5	4	1.3
27.	Blank	10			0
28.	Const. Speed	6	4		0.4

(1) Runs 1, 14, 24 and 27 were conducted without exhaust sample.

TABLE 11C. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Tractor 125
Date: January 26, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	Average
1.	Blank	2	8		0.8
2.	Const. Speed	3	7		0.7
3.	Idle		10		1.0
4.	Accel	3	7		0.7
5.	Const. Speed	2	7	1	0.9
6.	Decel		6	4	1.4
7.	Idle		9	1	1.1
8.	Idle-Accel	2	8		0.8
9.	Idle-Accel	1	7	2	1.1
10.	Const. Speed	5	5		0.5
11.	Decel		8	2	1.2
12.	Const. Speed	10			0
13.	Accel	2	7	1	0.9
14.	Blank	1	9		0.9
15.	Idle-Accel	1	9		0.9
16.	Const. Speed	4	6		0.6
17.	Idle	2	8		0.8
18.	Decel	2	7	1	0.9
19.	Idle-Accel	2	8		0.8
20.	Const. Speed	1	7	2	1.1
21.	Accel	1	7	2	1.1
22.	Decel		10		1.0
23.	Accel		10		1.0
24.	Blank	9	1		0.1
25.	Const. Speed	1	8	1	1.0
26.	Idle		9	1	1.1
27.	Blank	9	1		0.1
28.	Const. Speed	3	6	1	0.8

(1) Runs 1, 14, 24 and 27 were conducted without exhaust sample.

TABLE 11D. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 114
Date: January 26, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"A" Aromatic Responses			
		0	1	2	Average
1.	Blank	8	2		0.2
2.	Const. Speed	10			0
3.	Idle	2	7	1	0.9
4.	Accel	4	6		0.6
5.	Const. Speed	6	4		0.4
6.	Decel	2	5	3	1.1
7.	Idle	3	4	3	1.0
8.	Idle-Accel	1	8	1	1.0
9.	Idle-Accel	3	6	1	0.8
10.	Const. Speed	4	6		0.6
11.	Decel	2	5	3	1.1
12.	Const. Speed	10			0
13.	Accel		10		1.0
14.	Blank	3	7		0.7
15.	Idle-Accel	2	5	3	1.1
16.	Const. Speed	5	3	2	0.7
17.	Idle	3	5	2	0.9
18.	Decel		5	5	1.5
19.	Idle-Accel	6	4		0.4
20.	Const. Speed	4	6		0.6
21.	Accel	5	4	1	0.6
22.	Decel	3	7		0.7
23.	Accel	3	6	1	0.8
24.	Blank	10			0
25.	Const. Speed	2	6	2	1.0
26.	Idle	1	7	3	1.1
27.	Blank	10			0
28.	Const. Speed	5	4	1	0.6

(1) Runs 1, 14, 24 and 27 were conducted without exhaust sample.

TABLE 11E. SERIES 4 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Tractor 114
Date: January 26, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	2	Average
1.	Blank	10			0
2.	Const. Speed	10			0
3.	Idle	9	1		0.1
4.	Accel	10			0
5.	Const. Speed	10			0
6.	Decel	9	1		0.1
7.	Idle	4	6		0.6
8.	Idle-Accel	9	1		0.1
9.	Idle-Accel	7	3		0.3
10.	Const. Speed	9	1		0.1
11.	Decel	2	8		0.8
12.	Const. Speed	10			0
13.	Accel	7	3		0.3
14.	Blank	8	2		0.2
15.	Idle-Accel	10			0
16.	Const. Speed	9	1		0.1
17.	Idle	7	3		0.3
18.	Decel	4	5	1	0.7
19.	Idle-Accel	6	4		0.4
20.	Const. Speed	8	2		0.2
21.	Accel	9	1		0.1
22.	Decel	4	5	1	0.7
23.	Accel	8	2		0.2
24.	Blank	10			0
25.	Const. Speed	10			0
26.	Idle	3	7		0.7
27.	Blank	10			0
28.	Const. Speed	10			0

(1) Runs 1, 14, 24 and 27 were conducted without exhaust sample.

TABLE 12. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 135
Date: January 27, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 3.	Const. Speed	5.3	1.7	1.0	0.7	0.5
13.	" "	2.9	0.7	0.8	0.2	0.3
20.	" "	3.8	1.0	0.9	1.3	0.3
26.	" "	3.5	1.0	0.8	0.8	0.5
		3.9	1.1	0.9	0.8	0.4
II. 10.	Const. Speed	3.7	1.1	1.0	0.8	0
14	" "	1.1	0.1	0.2	0.4	0
21.	" "	3.2	0.6	0.6	0.9	0.3
25.	" "	3.1	0.5	0.5	0.8	0.6
		2.8	0.6	0.6	0.7	0.2
III. 4.	Idle	3.4	0.8	0.7	0.3	0.7
12.	"	3.7	1.0	0.9	0.9	0.3
19.	"	3.8	1.2	0.9	0.9	0.5
23.	"	1.6	0.7	0.2	0.2	0
		3.1	0.9	0.7	0.6	0.4
IV. 6.	Idle - Accel	2.9	0.6	0.7	0.6	0.2
8.	" "	3.5	1.1	0.7	0.7	0.2
17.	" "	3.0	0.4	0.6	0.9	0.6
22.	" "	3.0	0.6	0.6	0.7	0.3
		3.1	0.7	0.7	0.7	0.3
V. 7.	Accel	3.4	0.6	0.6	0.9	0.3
9.	"	3.3	0.8	0.8	0.7	0.3
18.	"	4.5	1.3	0.8	1.3	0.6
28.	"	3.6	1.0	1.0	0.9	0.6
		3.7	0.9	0.8	1.0	0.5
VI. 1.	Decel	5.9	1.9	1.4	1.0	0.8
15.	"	5.7	1.7	1.2	1.5	0.9
16.	"	5.9	1.7	1.3	1.4	1.1
27.	"	6.1	2.0	1.4	1.3	1.2
		5.9	1.8	1.3	1.3	1.0

(1) Runs 2, 5, 11 and 24 were conducted without exhaust sample.

TABLE 12A. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Diesel Composite Standard)

Vehicle: Tractor 135
Date: January 27, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run	Operating	"D" Composite Responses								
No. (1)	Condition	0	1	2	3	4	5	6	7	Average
1.	Decel						3	5	2	5.9
2.	Blank					3	7			4.2
3.	Const. Speed						7	3		5.3
4.	Idle	2				6	2			3.4
5.	Blank	9	1							0.1
6.	Idle-Accel			1	9					2.9
7.	Accel		1	1	1	7				3.4
8.	Idle-Accel			1	4	4	1			3.5
9.	Accel		1	1	2	6				3.3
10.	Const. Speed				5	3	2			3.7
11.	Blank				2	7	1			3.9
12.	Idle				3	7				3.7
13.	Const. Speed	2			3	5				2.9
14.	Const. Speed	4	2	3	1					1.1
15.	Decel						3	7		5.7
16.	Decel						2	7	1	5.9
17.	Idle-Accel			1	8	1				3.0
18.	Accel					5	5			4.5
19.	Idle				4	4	2			3.8
20.	Const. Speed				3	6	1			3.8
21.	Const. Speed			3	3	3	1			3.2
22.	Idle-Accel				10					3.0
23.	Idle	2		8						1.6
24.	Blank	7	1		2					0.7
25.	Const. Speed			3	3	4				3.1
26.	Const. Speed			2	1	7				3.5
27.	Decel						1	7	2	6.1
28.	Accel				5	4	1			3.6

(1) Runs 2, 5, 11 and 24 were conducted without exhaust sample.

TABLE 12B. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Tractor 135
Date: January 27, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	3	Average
1.	Decel		1	9		1.9
2.	Blank		6	4		1.4
3.	Const. Speed		3	7		1.7
4.	Idle	3	6	1		0.8
5.	Blank	9	1			0.1
6.	Idle-Accel	4	6			0.6
7.	Accel	4	6			0.6
8.	Idle-Accel	2	5	3		1.1
9.	Accel	3	6	1		0.8
10.	Const. Speed		9	1		1.1
11.	Blank		10			1.0
12.	Idle		10			1.0
13.	Const. Speed	3	7			0.7
14.	Const. Speed	9	1			0.1
15.	Decel		3	7		1.7
16.	Decel	1	2	6	1	1.7
17.	Idle-Accel	6	4			0.4
18.	Accel	2	3	5		1.3
19.	Idle	1	6	3		1.2
20.	Const. Speed	1	8	1		1.0
21.	Const. Speed	4	6			0.6
22.	Idle-Accel	4	6			0.6
23.	Idle	3	7			0.7
24.	Blank	8	2			0.2
25.	Const. Speed	5	5			0.5
26.	Const. Speed		10			1.0
27.	Decel		1	8	1	2.0
28.	Accel		10			1.0

(1) Runs 2, 5, 11 and 24 were conducted without exhaust sample.

TABLE 12C. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Truck 135
Date: January 27, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses				
		0	1	2	3	Average
1.	Decel		6	4		1.4
2.	Blank		10			0.1
3.	Const. Speed	2	6	2		1.0
4.	Idle	3	7			0.7
5.	Blank	9	1			0.1
6.	Idle-Accel	3	7			0.7
7.	Accel	4	6			0.6
8.	Idle-Accel	3	7			0.7
9.	Accel	2	8			0.8
10.	Const. Speed		10			1.0
11.	Blank	3	7			0.7
12.	Idle	1	9			0.9
13.	Const. Speed	2	8			0.8
14.	Const. Speed	8	2			0.2
15.	Decel		8	2		1.2
16.	Decel	1	5	4		1.3
17.	Idle-Accel	4	6			0.6
18.	Accel	3	6	1		0.8
19.	Idle	2	7	1		0.9
20.	Const. Speed	1	9			0.9
21.	Const. Speed	4	6			0.6
22.	Idle-Accel	4	6			0.6
23.	Idle	8	2			0.2
24.	Blank	9	1			0.1
25.	Const. Speed	5	5			0.5
26.	Const. Speed	2	8			0.8
27.	Decel		7	2	1	1.4
28.	Accel	2	7		1	1.0

(1) Runs 2, 5, 11 and 24 were conducted without exhaust sample.

TABLE 12D. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 135
Date: January 27, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"A" Aromatic Responses			
		0	1	2	Average
1.	Decel	2	6	2	1.0
2.	Blank	2	8		0.8
3.	Const. Speed	5	3	2	0.7
4.	Idle	7	3		0.3
5.	Blank	10			0
6.	Idle-Accel	4	6		0.6
7.	Accel	2	7	1	0.9
8.	Idle-Accel	4	5	1	0.7
9.	Accel	3	7		0.7
10.	Const. Speed	3	6	1	0.8
11.	Blank	5	4	1	0.6
12.	Idle	3	5	2	0.9
13.	Const. Speed	8	2		0.2
14.	Const. Speed	6	4		0.4
15.	Decel		5	5	1.5
16.	Decel		6	4	1.4
17.	Idle-Accel	2	7	1	0.9
18.	Accel		7	3	1.3
19.	Idle	3	5	2	0.9
20.	Const. Speed	2	3	5	1.3
21.	Const. Speed	2	7	1	0.9
22.	Idle-Accel	3	7		0.7
23.	Idle	8	2		0.2
24.	Blank	7	3		0.3
25.	Const. Speed	4	4	2	0.8
26.	Const. Speed	3	6	1	0.8
27.	Decel		7	3	1.3
28.	Accel	3	5	2	0.9

(1) Runs 2, 5, 11 and 24 were conducted without exhaust sample.

TABLE 12E. SERIES 5 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Tractor 135
Date: January 27, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run	Operating	"P" Pungent Responses			
No. (1)	Condition	0	1	2	Average
1.	Decel	2	8		0.8
2.	Blank	4	6		0.6
3.	Const. Speed	5	5		0.5
4.	Idle	4	5	1	0.7
5.	Blank	10			0
6.	Idle-Accel	8	2		0.2
7.	Accel	7	3		0.3
8.	Idle-Accel	8	2		0.2
9.	Accel	7	3		0.3
10.	Const. Speed	10			0
11.	Blank	7	3		0.3
12.	Idle	7	3		0.3
13.	Const. Speed	7	3		0.3
14.	Const. Speed	10			0
15.	Decel	2	7	1	0.9
16.	Decel	3	3	4	1.1
17.	Idle-Accel	4	6		0.6
18.	Accel	4	6		0.6
19.	Idle	5	5		0.5
20.	Const. Speed	7	3		0.3
21.	Const. Speed	7	3		0.3
22.	Idle-Accel	7	3		0.3
23.	Idle	10			0
24.	Blank	10			0
25.	Const. Speed	6	2	2	0.6
26.	Const. Speed	6	3	1	0.5
27.	Decel	2	4	4	1.2
28.	Accel	5	4	1	0.6

(1) Runs 2, 5, 11 and 24 were conducted without exhaust sample

TABLE 13. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 282
Date: January 30, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	Average Panel Responses "D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 1.	Const. Speed	3.4	0.9	0.8	0.6	0.2
15.	" "	3.2	0.7	0.9	0.7	0.1
19.	" "	2.6	0.7	0.5	0.9	0.1
23.	" "	1.9	0.3	1.0	0.6	0
		2.8	0.7	0.8	0.7	0.1
II. 5.	Const. Speed	1.1	0.3	0.4	0.5	0
9.	" "	1.3	0.5	0.4	0.3	0
17.	" "	3.2	0.4	0.7	0.9	0.2
26.	" "	3.1	1.0	0.9	0.8	0.2
		2.2	0.6	0.6	0.6	0.1
III. 3.	Idle	2.0	0.6	0.8	0.2	0.2
7.	"	3.6	0.8	0.9	1.3	0.3
20.	"	4.1	1.1	1.1	0.8	0.4
28.	"	4.3	0.9	1.1	0.8	0.3
		3.5	0.9	1.0	0.8	0.3
IV. 13.	Idle - Accel	2.6	0.5	1.0	0.9	1
16.	" "	3.7	0.8	0.9	0.9	0.1
22.	" "	2.5	0.6	1.0	0.6	0
25.	" "	2.6	0.5	1.0	0.9	0
		2.9	0.6	1.0	0.8	0
V. 6.	Accel	2.9	0.7	0.9	0.7	0.2
8.	"	1.9	0.4	0.9	0.7	0
18.	"	3.5	1.0	1.0	0.9	0.1
27.	"	2.4	0.7	0.9	0.5	0.2
		2.7	0.7	0.9	0.7	0.1
VI. 2.	Decel	5.1	1.2	1.1	0.8	0.7
11.	"	5.4	1.5	1.1	1.3	0.4
12.	"	4.2	1.0	1.0	1.2	0.2
21.	"	5.0	1.3	1.1	1.0	0.4
		4.9	1.3	1.1	1.1	0.4

(1) Runs 4, 10, 14 and 24 were conducted without exhaust sample

TABLE 13A. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS

("D" Diesel Composite Standard)

Vehicle: Tractor 282
Date: January 30, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"D" Composite Responses 0	1	2	3	4	5	6	Average
1.	Const. Speed				6	4			3.4
2.	Decel						9	1	5.1
3.	Idle	2		4	4				2.0
4.	Blank	4	5	1					0.7
5.	Const. Speed	3	4	2	1				1.1
6.	Accel			3	5	2			2.9
7.	Idle				5	4	1		3.6
8.	Accel		1	9					1.9
9.	Const. Speed	2	5	1	2				1.3
10.	Blank	4	5	1					0.7
11.	Decel						6	4	5.4
12.	Decel			1	2	1	6		4.2
13.	Idle-Accel		1	5	1	3			2.6
14.	Blank		4	4	2				1.8
15.	Const. Speed			3	2	5			3.2
16.	Idle-Accel			2	2	3	3		3.7
17.	Const. Speed	1		1	3	4	1		3.2
18.	Accel			1	4	4	1		3.5
19.	Const. Speed	2	2		1	4	1		2.6
20.	Idle			1	1	4	4		4.1
21.	Decel					1	8	1	5.0
22.	Idle-Accel			6	3	1			2.5
23.	Const. Speed		2	7	1				1.9
24.	Blank	7		3					0.6
25.	Idle-Accel			6	2	2			2.6
26.	Const. Speed			3	5		2		3.1
27.	Accel			7	2	1			2.4
28.	Idle					7	3		4.3

(1) Runs 4, 10, 14 and 24 were conducted without exhaust sample.

TABLE 13B SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Tractor 282
Date: January 30, 1967

Operating Conditions: See Table 3
Fuel: Refererence No. 2

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	Average
1.	Const. Speed	1	9		0.9
2.	Decel		8	2	1.2
3.	Idle	4	6		0.6
4.	Blank	8	2		0.2
5.	Const. Speed	7	3		0.3
6.	Accel	3	7		0.7
7.	Idle	3	6	1	0.8
8.	Accel	6	4		0.4
9.	Const. Speed	5	5		0.5
10.	Blank	9	1		0.1
11.	Decel		5	5	1.5
12.	Decel	1	8	1	1.0
13.	Idle-Accel	5	5		0.5
14.	Blank	5	5		0.5
15.	Const. Speed	3	7		0.7
16.	Idle-Accel	2	8		0.8
17.	Const. Speed	6	4		0.4
18.	Accel	2	6	2	1.0
19.	Const. Speed	4	5	1	0.7
20.	Idle	1	7	2	1.1
21.	Decel		7	3	1.3
22.	Idle-Accel	4	6		0.6
23.	Const. Speed	7	3		0.3
24.	Blank	9	1		0.1
25.	Idle-Accel	5	5		0.5
26.	Const. Speed	1	8	1	1.0
27.	Accel	3	7		0.7
28.	Idle	1	9		0.9

(1) Runs 4, 10, 14 and 24 were conducted without exhaust sample.

TABLE 13C. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Tractor 282
Date: January 30, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses			
		0	1	2	Average
1.	Const. Speed	2	8		0.8
2.	Decel		9	1	1.1
3.	Idle	2	8		0.8
4.	Blank	8	2		0.2
5.	Const. Speed	6	4		0.4
6.	Accel	1	9		0.9
7.	Idle	1	9		0.9
8.	Accel	1	9		0.9
9.	Const. Speed	6	4		0.4
10.	Blank	7	3		0.3
11.	Decel		9	1	1.1
12.	Decel		10		1.0
13.	Idle-Accel		10		1.0
14.	Blank	5	5		0.5
15.	Const. Speed	1	9		0.9
16.	Idle-Accel	1	9		0.9
17.	Const. Speed	3	7		0.7
18.	Accel		10		1.0
19.	Const. Speed	5	5		0.5
20.	Idle		9	1	1.1
21.	Decel		9	1	1.1
22.	Idle-Accel	1	8	1	1.0
23.	Const. Speed		10		1.0
24.	Blank	8	2		0.2
25.	Idle-Accel	1	8	1	1.0
26.	Const. Speed	1	9		0.9
27.	Accel	1	9		0.9
28.	Idle	1	7	2	1.1

(1) Runs 4, 10, 14 and 24 were conducted without exhaust sample.

TABLE 13D. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 282
Date: January 30, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	Average
1.	Const. Speed	5	4	1	0.6
2.	Decel	3	6	1	0.8
3.	Idle	8	2		0.2
4.	Blank	7	3		0.3
5.	Const. Speed	6	3	1	0.5
6.	Accel	4	5	1	0.7
7.	Idle		7	3	1.3
8.	Accel	3	7		0.7
9.	Const. Speed	7	3		0.3
10.	Blank	7	2	1	0.4
11.	Decel		7	3	1.3
12.	Decel	1	6	3	1.2
13.	Idle-Accel	3	5	2	0.9
14.	Blank	5	4	1	0.6
15.	Const. Speed	3	7		0.7
16.	Idle-Accel	2	7	1	0.9
17.	Const. Speed	2	7	1	0.9
18.	Accel	1	9		0.9
19.	Const. Speed	4	3	3	0.9
20.	Idle	3	6	1	0.8
21.	Decel	2	6	2	1.0
22.	Idle-Accel	4	6		0.6
23.	Const. Speed	5	4	1	0.6
24.	Blank	8	1	1	0.3
25.	Idle-Accel	2	7	1	0.9
26.	Const. Speed	3	6	1	0.8
27.	Accel	6	3	1	0.5
28.	Idle	3	6	1	0.8

(1) Runs 4, 10, 14 and 24 were conducted without exhaust sample.

TABLE 13E. SERIES 6 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Truck 282
Date: January 30, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"P" Pungent Responses			
		0	1	2	Average
1.	Const. Speed	8	2		0.2
2.	Decel	3	7		0.7
3.	Idle	8	2		0.2
4.	Blank	10			0
5.	Const. Speed	10			0
6.	Accel	8	2		0.2
7.	Idle	7	3		0.3
8.	Accel	10			0
9.	Const. Speed	10			0
10.	Blank	10			0
11.	Decel	6	4		0.4
12.	Decel	8	2		0.2
13.	Idle-Accel	10			0
14.	Blank	10			0
15.	Const. Speed	9	1		0.1
16.	Idle-Accel	9	1		0.1
17.	Const. Speed	8	2		0.2
18.	Accel	9	1		0.1
19.	Const. Speed	9	1		0.1
20.	Idle	6	4		0.4
21.	Decel	6	4		0.4
22.	Idle-Accel	10			0
23.	Const. Speed	10			0
24.	Blank	10			0
25.	Idle-Accel	10			0
26.	Const. Speed	8	2		0.2
27.	Accel	8	2		0.2
28.	Idle	7	3		0.3

(1) Runs 4, 10, 14 and 24 were conducted without exhaust sample.

TABLE 14. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 286
Date: January 31, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 6.	Const. Speed	3.6	0.8	0.5	1.3	0.3
18.	" "	3.3	0.6	0.8	1.0	0
19.	" "	2.7	0.5	1.0	0.8	0
28.	" "	3.2	0.7	1.0	1.0	0
		3.2	0.7	0.8	1.0	0.1
II. 3.	Const. Speed	3.3	0.7	0.9	0.4	0.2
9.	" "	1.5	0.4	0.5	0.2	0.1
22.	" "	0.3	0.1	0.2	0.1	0
26.	" "	0.8	0.1	0.3	0.2	0
		1.5	0.3	0.5	0.2	0.1
III. 4.	Idle	4.1	0.9	0.7	1.0	0.4
12.	"	3.2	0.8	0.8	0.8	0.3
21.	"	3.8	0.8	0.8	0.6	0.5
27.	"	4.3	1.1	0.9	0.9	0
		3.9	0.9	0.8	0.8	0.3
IV. 5.	Idle - Accel	3.6	0.7	0.9	0.9	0.2
10.	" "	4.1	0.1	0.7	1.3	0.4
13.	" "	2.8	0.9	0.9	0.5	0.3
17.	" "	2.8	0.7	0.6	0.9	0.1
		3.3	0.8	0.8	0.9	0.3
V. 7.	Accel	3.3	0.9	0.8	1.0	0.5
15.	"	3.0	0.7	0.8	0.5	0.2
16.	"	2.2	0.6	0.6	0.6	0.1
24.	"	3.1	0.7	1.1	0.7	0
		2.9	0.7	0.9	0.7	0.2
VI. 2.	Decel	4.0	1.1	0.9	0.7	0.4
8.	"	5.1	1.4	0.9	0.9	0.6
20.	"	4.6	1.1	0.9	0.8	0.6
25.	"	4.7	0.9	0.8	0.9	0.3
		4.6	1.4	0.9	0.8	0.5

(1) Runs 1, 11, 14 and 23 were conducted without exhaust sample.

TABLE 14A. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Diesel Composite Standard)

Vehicle: Tractor 286
Date: January 31, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"D" Composite Responses							
		0	1	2	3	4	5	6	Average
1.	Blank		5	3	2				1.7
2.	Decel				2	7		1	4.0
3.	Const. Speed			1	5	4			3.3
4.	Idle				2	5	3		4.1
5.	Idle-Accel			1	2	7			3.6
6.	Const. Speed				4	6			3.6
7.	Accel				7	3			3.3
8.	Decel						9	1	5.1
9.	Const. Speed	1	4	4	1				1.5
10.	Idle-Accel				1	7	2		4.1
11.	Blank	2			1	5	2		3.3
12.	Idle			3	4	1	2		3.2
13.	Idle-Accel			5	2	3			2.8
14.	Blank	9	1						0.1
15.	Accel			2	6	2			3.0
16.	Accel			8	2				2.2
17.	Idle-Accel			2	8				2.8
18.	Const. Speed			2	3	5			3.3
19.	Const. Speed		1	4	2	3			2.7
20.	Decel					5	4	1	4.6
21.	Idle				5	2	3		3.8
22.	Const. Speed	8	1	1					0.3
23.	Blank				2	7	1		3.9
24.	Accel			1	7	2			3.1
25.	Decel					3	7		4.7
26.	Const. Speed	8				2			0.8
27.	Idle					7	3		4.3
28.	Const. Speed			2	4	4			3.2

(1) Runs 1, 11, 14 and 23 were conducted without exhaust sample.

TABLE 14B. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Tractor 286
Date: January 31, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	Average
1.	Blank	4	6		0.6
2.	Decel		9	1	1.1
3.	Const. Speed	3	7		0.7
4.	Idle	2	7	1	0.9
5.	Idle-Accel	3	7		0.7
6.	Const. Speed	2	8		0.8
7.	Accel	1	9		0.9
8.	Decel		6	4	1.4
9.	Const. Speed	6	4		0.4
10.	Idle-Accel	2	6	2	1.0
11.	Blank	3	7		0.7
12.	Idle	2	6	1	0.8
13.	Idle-Accel	1	9		0.9
14.	Blank	10			0
15.	Accel	3	7		0.7
16.	Accel	4	6		0.6
17.	Idle-Accel	3	7		0.7
18.	Const. Speed	4	6		0.6
19.	Const. Speed	5	5		0.5
20.	Decel	1	7	2	1.1
21.	Idle	3	6	1	0.8
22.	Const. Speed	9	1		0.1
23.	Blank	1	8	1	1.0
24.	Accel	3	7		0.7
25.	Decel	2	7	1	0.9
26.	Const. Speed	9	1		0.1
27.	Idle		9	1	1.1
28.	Const. Speed	4	5	1	0.7

(1) Runs 1, 11, 14 and 23 were conducted without exhaust sample.

TABLE 14C. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Truck 286
Date: January 31, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	Average
1.	Blank	5	5		0.5
2.	Decel	1	9		0.9
3.	Const. Speed	2	7	1	0.9
4.	Idle	4	5	1	0.7
5.	Idle-Accel	3	5	2	0.9
6.	Const. Speed	5	5		0.5
7.	Accel	2	8		0.8
8.	Decel	1	9		0.9
9.	Const. Speed	5	5		0.5
10.	Idle-Accel	3	7		0.7
11.	Blank	3	7		0.7
12.	Idle	2	8		0.8
13.	Idle-Accel	1	9		0.9
14.	Blank	9	1		0.1
15.	Accel	2	8		0.8
16.	Accel	4	6		0.6
17.	Idle-Accel	4	6		0.6
18.	Const. Speed	2	8		0.8
19.	Const. Speed		10		1.0
20.	Decel	1	9		0.9
21.	Idle	2	8		0.8
22.	Const. Speed	8	2		0.2
23.	Blank	3	6	1	0.8
24.	Accel		9	1	1.1
25.	Decel	2	8		0.8
26.	Const. Speed	8	1	1	0.3
27.	Idle	1	9		0.9
28.	Const. Speed	1	8	1	1.0

(1) Runs 1, 11, 14 and 23 were conducted without exhaust sample.

TABLE 14D. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 286
Date: January 31, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	Average
1.	Blank	8	2		0.2
2.	Decel	3	7		0.7
3.	Const. Speed	6	4		0.4
4.	Idle	3	4	3	1.0
5.	Idle-Accel	3	5	2	0.9
6.	Const. Speed		7	3	1.3
7.	Accel	2	6	2	1.0
8.	Decel	2	7	1	0.9
9.	Const. Speed	8	2		0.2
10.	Idle-Accel	1	5	4	1.3
11.	Blank	8	2		0.2
12.	Idle	4	4	2	0.8
13.	Idle-Accel	6	3	1	0.5
14.	Blank	10			0
15.	Accel	6	3	1	0.5
16.	Accel	4	6		0.6
17.	Idle-Accel	1	9		0.9
18.	Const. Speed	2	6	2	1.0
19.	Const. Speed	4	4	2	0.8
20.	Decel	2	8		0.8
21.	Idle	5	4	1	0.6
22.	Const. Speed	9	1		0.1
23.	Blank	4	6		0.6
24.	Accel	3	7		0.7
25.	Decel	4	3	3	0.9
26.	Const. Speed	8	2		0.2
27.	Idle	2	7	1	0.9
28.	Const. Speed	3	4	3	1.0

(1) Runs 1, 11, 14 and 23 were conducted without exhaust sample.

TABLE 14E. SERIES 7 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Truck 286
Date: January 31, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	Average
1.	Blank	10		0
2.	Decel	6	4	0.4
3.	Const. Speed	8	2	0.2
4.	Idle	6	4	0.4
5.	Idle-Accel	8	2	0.2
6.	Const. Speed	7	3	0.3
7.	Accel	5	5	0.5
8.	Decel	4	6	0.6
9.	Const. Speed	9	1	0.1
10.	Idle-Accel	6	4	0.4
11.	Blank	4	6	0.6
12.	Idle	7	3	0.3
13.	Idle-Accel	7	3	0.3
14.	Blank	10		0
15.	Accel	8	2	0.2
16.	Accel	9	1	0.1
17.	Idle-Accel	9	1	0.1
18.	Const. Speed	10		0
19.	Const. Speed	10		0
20.	Decel	4	6	0.6
21.	Idle	5	5	0.5
22.	Const. Speed	10		0
23.	Blank	9	1	0.1
24.	Accel	10		0
25.	Decel	7	3	0.3
26.	Const. Speed	10		0
27.	Idle	10		0
28.	Const. Speed	10		0

(1) Runs 1, 11, 14 and 23 were conducted without exhaust sample.

TABLE 15. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 284
Date: February 1, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 8.	Const. Speed	3.5	0.7	0.9	1.1	0.5
11.	" "	2.8	0.4	1.1	0.9	0.4
14.	" "	0.9	0	0.5	0.4	0
22.	" "	2.9	0.6	0.8	0.9	0.6
		2.5	0.4	0.8	0.8	0.4
II. 5.	Const. Speed	1.0	0.2	0.4	0.2	0.1
15.	" "	0.2	0	0	0.1	0
20.	" "	2.6	0.5	0.8	0.3	0.1
25.	" "	1.1	0.4	0.2	0.4	0
		1.2	0.3	0.4	0.3	0.1
III. 10.	Idle	2.1	0.3	0.9	0.7	0.1
19.	"	2.5	0.5	0.6	0.8	0.3
23.	"	4.4	1.4	0.9	1.0	0.3
27.	"	2.7	0.7	0.9	0.6	0.4
		2.9	0.7	0.8	0.8	0.3
IV. 3.	Idle - Accel	1.9	0.4	0.9	0.4	0
9.	" "	2.5	0.5	0.9	0.7	0.3
18.	" "	2.1	0.4	0.9	0.5	0.1
26.	" "	2.5	0.7	1.1	0.5	0.2
		2.3	0.5	1.0	0.5	0.2
V. 4.	Accel	1.6	0.3	0.8	0.6	0
12.	"	1.6	0.2	0.5	0.6	0.2
13.	"	2.2	0.4	0.8	0.5	0.2
24.	"	2.5	0.8	0.9	0.6	0.1
		2.0	0.4	0.8	0.6	0.1
VI. 2.	Decel	3.3	0.9	1.0	0.6	0.5
7.	"	4.1	1.1	1.0	0.7	0.5
17.	"	4.2	0.9	0.7	1.3	0.6
28.	"	4.3	1.5	1.1	1.0	0.4
		4.0	1.1	1.0	0.9	0.5

(1) Runs 1, 6, 16 and 21 were conducted without exhaust sample.

TABLE 15A. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Diesel Composite Standard)

Vehicle: Tractor 284
Date: February 1, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"D" Composite Responses						
		0	1	2	3	4	5	Average
1.	Blank	10						0
2.	Decel				7	3		3.3
3.	Idle-Accel		1	9				1.9
4.	Accel		5	4	1			1.6
5.	Const. Speed	4	4		2			1.0
6.	Blank	5	4	1				0.6
7.	Decel					9	1	4.1
8.	Const. Speed				5	5		3.5
9.	Idle-Accel		1	3	6			2.5
10.	Idle			9	1			2.1
11.	Const. Speed			4	4	2		2.8
12.	Accel		6	2	2			1.6
13.	Accel		2	5	2	1		2.2
14.	Const. Speed	2	7	1				0.9
15.	Const. Speed	8	2					0.2
16.	Blank		6	3	1			1.5
17.	Decel					8	2	4.2
18.	Idle-Accel		2	5	3			2.1
19.	Idle			5	5			2.5
20.	Const. Speed			5	4	1		2.6
21.	Blank	9	1					0.1
22.	Const. Speed			2	7	1		2.9
23.	Idle					6	4	4.4
24.	Accel			7	1	2		2.5
25.	Const. Speed		9	1				1.1
26.	Idle-Accel			7	1	2		2.5
27.	Idle			3	7			2.7
28.	Decel				2	3	5	4.3

(1) Runs 1, 6, 16 and 21 were conducted without exhaust sample.

TABLE 15B. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Tractor 284 Operating Conditions: See Table 3
Date: February 1, 1967 Fuel: Reference No. 2

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	Average
1.	Blank	10			0
2.	Decel	1	9		0.9
3.	Idle-Accel	6	4		0.4
4.	Accel	7	3		0.3
5.	Const. Speed	8	2		0.2
6.	Blank	10			0
7.	Decel		9	1	1.1
8.	Const. Speed	3	7		0.7
9.	Idle-Accel	5	5		0.5
10.	Idle	7	3		0.3
11.	Const. Speed	6	4		0.4
12.	Accel	8	2		0.2
13.	Accel	6	4		0.4
14.	Const. Speed	10			0
15.	Const. Speed	10			0
16.	Blank	8	2		0.2
17.	Decel	2	7	1	0.9
18.	Idle-Accel	6	4		0.4
19.	Idle	5	5		0.5
20.	Const. Speed	5	5		0.5
21.	Blank	10			0
22.	Const. Speed	4	6		0.6
23.	Idle		6	4	1.4
24.	Accel	3	6	1	0.8
25.	Const. Speed	6	4		0.4
26.	Idle-Accel	3	7		0.7
27.	Idle	3	7		0.7
28.	Decel	1	3	6	1.5

(1) Runs 1, 6, 16 and 21 were conducted without exhaust sample.

TABLE 15C. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Tractor 284
Date: February 1, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses				
		0	0.5	1	2	Average
1.	Blank	10				0
2.	Decel	1		8	1	1.0
3.	Idle-Accel	2		7	1	0.9
4.	Accel	4	1	3	2	0.8
5.	Const. Speed	6		4		0.4
6.	Blank	6	1	1	2	0.6
7.	Decel	1		8	1	1.0
8.	Const. Speed	3		5	2	0.9
9.	Idle-Accel	1		9		0.9
10.	Idle	1		9		0.9
11.	Const. Speed	1		7	2	1.1
12.	Accel	5	1	4		0.5
13.	Accel	2		8		0.8
14.	Const. Speed	5	1	4		0.5
15.	Const. Speed	10				0
16.	Blank	2	1	7		0.8
17.	Decel	3		7		0.7
18.	Idle-Accel	1		9		0.9
19.	Idle	4		6		0.6
20.	Const. Speed	2		8		0.8
21.	Blank	10				0
22.	Const. Speed	3		6	1	0.8
23.	Idle	2		7	1	0.9
24.	Accel	2		7	1	0.9
25.	Const. Speed	8	1	1		0.2
26.	Idle-Accel	2		5	3	1.1
27.	Idle	2		7	1	0.9
28.	Decel	2		5	3	1.1

(1) Runs 1, 6, 16 and 21 were conducted without exhaust sample

TABLE 15D. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 284
Date: February 1, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	Average
1.	Blank	10			0
2.	Decel	5	4	1	0.6
3.	Idle-Accel	6	4		0.4
4.	Accel	4	6		0.6
5.	Const. Speed	8	2		0.2
6.	Blank	8	2		0.2
7.	Decel	3	7		0.7
8.	Const. Speed	1	7	2	1.1
9.	Idle-Accel	4	5	1	0.7
10.	Idle	3	7		0.7
11.	Const. Speed	1	9		0.9
12.	Accel	4	6		0.6
13.	Accel	5	5		0.5
14.	Const. Speed	6	4		0.4
15.	Const. Speed	9	1		0.1
16.	Blank	5	5		0.5
17.	Decel		7	3	1.3
18.	Idle-Accel	5	5		0.5
19.	Idle	2	8		0.8
20.	Const. Speed	7	3		0.3
21.	Blank	9	1		0.1
22.	Const. Speed	3	5	2	0.9
23.	Idle		10		1.0
24.	Accel	4	6		0.6
25.	Const. Speed	6	4		0.4
26.	Idle-Accel	6	3	1	0.5
27.	Idle	4	6		0.6
28.	Decel	2	6	2	1.0

(1) Runs 1, 6, 16 and 21 were conducted without exhaust sample.

TABLE 15E. SERIES 8 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Tractor 284	Operating Conditions: See Table 3
Date: February 1, 1967	Fuel: Reference No. 2

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	Average
1.	Blank	10		0
2.	Decel	5	5	0.5
3.	Idle-Accel	10		0
4.	Accel	10		0
5.	Const. Speed	9	1	0.1
6.	Blank	10		0
7.	Decel	5	5	0.5
8.	Const. Speed	5	5	0.5
9.	Idle-Accel	7	3	0.3
10.	Idle	9	1	0.1
11.	Const. Speed	6	4	0.4
12.	Accel	8	2	0.2
13.	Accel	8	2	0.2
14.	Const. Speed	10		0
15.	Const. Speed	10		0
16.	Blank	10		0
17.	Decel	4	6	0.6
18.	Idle-Accel	9	1	0.1
19.	Idle	7	3	0.3
20.	Const. Speed	9	1	0.1
21.	Blank	10		0
22.	Const. Speed	4	6	0.6
23.	Idle	7	3	0.3
24.	Accel	9	1	0.1
25.	Const. Speed	10		0
26.	Idle-Accel	8	2	0.2
27.	Idle	6	4	0.4
28.	Decel	6	4	0.4

(1) Runs 1, 6, 16 and 21 were conducted without exhaust sample.

TABLE 16. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 285
Date: February 2, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	Average Panel Responses "D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 1.	Const. Speed	2.9	0.8	0.9	0.3	0
6.	" "	3.4	0.8	1.2	0.6	0.1
16.	" "	3.2	0.2	0.7	0.9	0
17.	" "	0.5	0	0.1	0.2	0
		2.5	0.5	0.5	0.5	0
II. 8.	Const. Speed	3.8	1.0	1.1	0.5	0.3
9.	" "	0.5	0	0.3	0	0
12.	" "	3.7	0.8	0.9	0.6	0.3
26.	" "	1.8	0.3	0.4	0.2	0.1
		2.5	0.5	0.7	0.3	0.2
III. 2.	Idle	3.9	1.1	1.1	0.7	0.5
11.	"	4.9	1.1	1.1	1.1	0.8
18.	"	3.5	0.8	0.9	0.5	0.5
28.	"	4.2	0.8	1.1	0.9	0.6
		4.1	1.0	1.1	0.8	0.6
IV. 4.	Idle - Accel	1.2	0.1	0.9	0.5	0
7.	" "	2.9	0.5	1.0	0.6	0
21.	" "	3.0	0.7	1.1	0.7	0.1
27.	" "	2.0	0.1	1.1	0.2	0.1
		2.3	0.4	1.0	0.5	0.1
V. 10.	Accel	3.0	0.7	1.0	0.6	0.2
14.	"	4.5	1.3	0.9	1.0	0.4
20.	"	3.1	0.7	0.9	0.8	0.4
23.	"	3.6	0.6	1.0	0.4	0.8
		3.6	0.8	1.0	0.7	0.5
VI. 3.	Decel	3.4	0.7	1.2	0.8	0.1
5.	"	4.4	1.0	1.2	0.8	0.6
15.	"	5.3	1.6	1.2	0.9	0.9
25.	"	5.4	1.4	1.2	1.7	0.8
		4.6	1.2	1.2	0.9	0.6

(1) Runs 13, 19, 22 and 24 were conducted without exhaust sample.

TABLE 16A. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("D" Diesel Composite Standard)

Vehicle: Tractor 285
Date: February 2, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"D" Composite Responses 0	1	2	3	4	5	6	Average
1.	Const. Speed			1	9				2.9
2.	Idle				4	3	3		3.9
3.	Decel			1	4	5			3.4
4.	Idle-Accel			9	1				1.2
5.	Decel				1	4	5		4.4
6.	Const. Speed			4	1	2	3		3.4
7.	Idle-Accel			1	9				2.9
8.	Const. Speed				2	8			3.8
9.	Const. Speed	6	3	1					0.5
10.	Accel			2	6	2			3.0
11.	Idle					1	9		4.9
12.	Const. Speed			1	1	8			3.7
13.	Blank				3	2	2	3	3.5
14.	Accel					5	5		4.5
15.	Decel					1	5	4	5.3
16.	Const. Speed		1	6	3				3.2
17.	Const. Speed	7	1	2					0.5
18.	Idle			1	3	6			3.5
19.	Blank			4	3	3			2.9
20.	Accel		1	2	2	5			3.1
21.	Idle-Accel			4	2	4			3.0
22.	Const. Speed						10		5.0
23.	Accel				5	4	1		3.6
24.	Blank	1		3	2	3	1		2.9
25.	Decel					1	4	5	5.4
26.	Const. Speed	3		3	4				1.8
27.	Idle-Accel			10					2.0
28.	Idle				2	4	4		4.2

(1) Runs 13, 19, 22 and 24, were conducted without exhaust sample.

TABLE 16B. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Truck 285
Date: February 2, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"B" Burnt Responses 0	1	2	Average
1.	Const. Speed	2	8		0.8
2.	Idle		9	1	1.1
3.	Decel	3	7		0.7
4.	Idle-Accel	9	1		0.1
5.	Decel	2	6	2	1.0
6.	Const. Speed	2	8		0.8
7.	Idle-Accel	5	5		0.5
8.	Const. Speed		10		1.0
9.	Const. Speed	10			0
10.	Accel	3	7		0.7
11.	Idle		9	1	1.1
12.	Const. Speed	2	8		0.8
13.	Blank	2	6	2	1.0
14.	Accel		7	3	1.3
15.	Decel		4	6	1.6
16.	Const. Speed	8	2		0.2
17.	Const. Speed	10			0
18.	Idle	2	8		0.8
19.	Blank	5	5		0.5
20.	Accel	4	5	1	0.7
21.	Idle-Accel	4	5	1	0.7
22.	Const. Speed		6	4	1.4
23.	Accel	4	6		0.6
24.	Blank	5	3	2	0.7
25.	Decel	1	4	5	1.4
26.	Const. Speed	7	3		0.3
27.	Idle-Accel	9	1		0.1
28	Idle	3	6	1	0.8

(1) Runs 13, 19, 22 and 24 were conducted without exhaust sample.

TABLE 16C. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Tractor 285
Date: February 2, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	Average
1.	Const. Speed	1	9		0.9
2.	Idle		9	1	1.1
3.	Decel	1	6	3	1.2
4.	Idle-Accel	1	9		0.9
5.	Decel	1	6	3	1.2
6.	Const. Speed		8	2	1.2
7.	Idle-Accel		10		1.0
8.	Const. Speed		9	1	1.1
9.	Const. Speed	7	3		0.3
10.	Accel		10		1.0
11.	Idle		9	1	1.1
12.	Const. Speed	2	7	1	0.9
13.	Blank	1	7	2	1.1
14.	Accel	2	7	1	0.9
15.	Decel	1	6	3	1.2
16.	Const. Speed	3	7		0.7
17.	Const. Speed	9	1		0.1
18.	Idle	1	9		0.9
19.	Blank		8	2	1.2
20.	Accel	1	9		0.9
21.	Idle-Accel		9	1	1.1
22.	Const. Speed		8	2	1.2
23.	Accel		10		1.0
24.	Blank	2	8		0.8
25.	Decel		8	2	1.2
26.	Const. Speed	6	4		0.4
27.	Idle-Accel	1	7	2	1.1
28.	Idle		9	1	1.1

(1) Runs 13, 19, 22 and 24 were conducted without exhaust sample.

TABLE 16D. SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 285
Date: February 2, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run	Operating	"A" Aromatic Responses				
No. (1)	Condition	0	1	2	3	Average
1.	Const. Speed	7	3			0.3
2.	Idle	3	7			0.7
3.	Decel	3	6	1		0.8
4.	Idle-Accel	5	5			0.5
5.	Decel	2	8			0.8
6.	Const. Speed	5	4	1		0.6
7.	Idle-Accel	4	6			0.6
8.	Const. Speed	5	5			0.5
9.	Const. Speed	10				0
10.	Accel	4	6			0.6
11.	Idle		9	1		1.1
12.	Const. Speed	4	6			0.6
13.	Blank	5	5			0.5
14.	Accel		10			1.0
15.	Decel	1	9			0.9
16.	Const. Speed	1	9			0.9
17.	Const. Speed	8	2			0.2
18.	Idle	6	3	1		0.5
19.	Blank	7	3			0.3
20.	Accel	2	8			0.8
21.	Idle-Accel	3	7			0.7
22.	Const. Speed	1	9			0.9
23.	Accel	6	4			0.4
24.	Blank	3	7			0.7
25.	Decel		4	5	1	1.7
26.	Const. Speed	8	2			0.2
27.	Idle-Accel	8	2			0.2
28.	Idle	2	7	1		0.9

(1) Runs 13, 19, 22 and 24 were conducted without exhaust sample.

TABLE 16E SERIES 9 VEHICLE VARIABILITY ODOR EVALUATION RESULTS

("P" Pungent Standard)

Vehicle: Tractor 285
Date: February 2, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	2	Average
1.	Const. Speed	10			0
2.	Idle	5	5		0.5
3.	Decel	9	1		0.1
4.	Idle-Accel	10			0
5.	Decel	4	6		0.6
6.	Const. Speed	9	1		0.1
7.	Idle-Accel	10			0
8.	Const. Speed	7	3		0.3
9.	Const. Speed	10			0
10.	Accel	8	2		0.2
11.	Idle	2	8		0.8
12.	Const. Speed	7	3		0.3
13.	Blank	5	3	2	0.7
14.	Accel	6	4		0.4
15.	Decel	2	7	1	0.9
16.	Const. Speed	10			0
17.	Const. Speed	10			0
18.	Idle	5	5		0.5
19.	Blank	8	2		0.2
20.	Accel	6	4		0.4
21.	Idle-Accel	9	1		0.1
22.	Const. Speed	6	4		0.4
23.	Accel	2	8		0.8
24.	Blank	8	2		0.2
25.	Decel	3	6	1	0.8
26.	Const. Speed	9	1		0.1
27.	Idle-Accel	9	1		0.1
28.	Idle	4	6		0.6

(1) Runs 13, 19, 22 and 24 were conducted without exhaust sample.

TABLE 17. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY

Vehicle: Tractor 283
Date: February 3, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

		Average Panel Responses				
Run No. (1)	Operating Condition	"D" Composite	"B" Burnt	"O" Oily	"A" Aromatic	"P" Pungent
I. 3.	Const. Speed	3.3	0.6	0.7	0.7	0.4
14.	" "	2.8	0	0.7	1.3	0.3
16.	" "	3.3	0.3	0.8	0.8	0.5
25.	" "	4.1	1.0	0.7	1.0	0.6
		3.4	0.5	0.7	1.0	0.5
II. 8.	Const. Speed	1.5	0.2	0.5	0.5	0.1
10.	" "	2.7	0.4	0.8	0.5	0.1
20.	" "	5.3	1.6	1.2	1.3	1.0
26.	" "	3.7	1.3	0.8	0.7	0.4
		3.3	0.9	0.8	0.8	0.4
III. 1.	Idle	3.7	0.8	1.2	0.7	0.5
13.	"	4.7	1.0	1.0	0.6	1.0
18.	"	4.2	0.8	0.9	1.6	0.8
27.	"	5.5	1.7	1.6	1.3	1.2
		4.5	1.1	1.2	0.8	0.9
IV. 7.	Idle - Accel	3.8	1.0	0.9	0.9	0.2
9.	" "	2.4	0.4	0.7	0.8	0.1
15.	" "	3.0	0.4	0.7	1.2	0.3
19.	" "	4.9	0.5	1.2	1.5	1.0
		3.5	0.6	0.9	1.1	0.4
V. 6.	Accel	2.2	0.4	0.9	0.5	0.2
12.	"	2.5	0.7	0.7	0.6	0.5
17.	"	2.7	0.6	1.0	0.7	0.7
24.	"	3.8	1.0	1.0	0.9	0.6
		2.8	0.7	0.9	0.7	0.5
VI. 4.	Decel	5.1	1.4	1.4	0.9	0.7
21.	"	6.6	1.5	1.5	1.1	1.3
22.	"	5.2	1.4	1.4	1.1	1.1
28.	"	5.1	1.5	1.5	1.2	1.1
		5.5	1.5	1.5	0.8	1.1

(1) Runs 2, 5, 11 and 23 were conducted without exhaust sample.

TABLE 17A. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION SUMMARY
("D" Diesel Composite Standard)

Vehicle: Tractor 283
Date: February 3, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"D" Composite Responses 0	1	2	3	4	5	6	Average
1.	Idle				4	5	1		3.7
2.	Blank	1	3	6					1.5
3.	Const. Speed			1	5	4			3.3
4.	Decel					2	5	3	5.1
5.	Blank	5	1		3	1			1.4
6.	Accel		2	6		2			2.2
7.	Idle-Accel			3		3	4		3.8
8.	Const. Speed	1	3	6					1.5
9.	Idle-Accel			6	4				2.4
10.	Const. Speed		2		7	1			2.7
11.	Blank	5	3	2					0.7
12.	Accel			5	5				2.5
13.	Idle					3	7		4.7
14.	Const. Speed			5	2	3			2.8
15.	Idle-Accel			2	6	2			3.0
16.	Const. Speed	1		4	5				3.3
17.	Accel			6	1	3			2.7
18.	Idle				2	4	4		4.2
19.	Idle-Accel					4	3	3	4.9
20.	Const. Speed						7	3	5.3
21.	Decel						4	6	6.6
22.	Decel				1	1	3	5	5.2
23.	Blank	2	2	4	2				1.6
24.	Accel			1	1	8			3.8
25.	Const. Speed			2	1	1	6		4.1
26.	Const. Speed	1				8	1		3.7
27.	Idle						5	5	[illegible].5
28.	Decel					2	5	3	5.1

(1) Runs 2, 5, 11 and 23 were conducted without exhaust sample.

TABLE 17B. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("B" Burnt-Smoky Standard)

Vehicle: Tractor 283
Date: February 3, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run	Operating	"B" Burnt Responses			
No. (1)	Condition	0	1	2	Average
1.	Idle	2	8		0.8
2.	Blank	8	2		0.2
3.	Const. Speed	4	6		0.6
4.	Decel		6	4	1.4
5.	Blank	7	3		0.3
6.	Accel	6	4		0.4
7.	Idle-Accel	1	8	1	1.0
8.	Const. Speed	8	2		0.2
9.	Idle-Accel	6	4		0.4
10.	Const. Speed	6	4		0.4
11.	Blank	5	5		0.5
12.	Accel	3	7		0.7
13.	Idle		10		1.0
14.	Const. Speed	10			0
15.	Idle-Accel	6	4		0.4
16.	Const. Speed	7	3		0.3
17.	Accel	5	4	1	0.6
18.	Idle	3	6	1	0.8
19.	Idle-Accel	5	5		0.5
20.	Const. Speed		4	6	1.6
21.	Decel		5	5	1.5
22.	Decel	1	4	5	1.4
23.	Blank	6	3	1	0.5
24.	Accel	1	8	1	1.0
25.	Const. Speed	2	6	2	1.0
26.	Const. Speed		7	3	1.3
27.	Idle		3	7	1.7
28.	Decel		5	5	1.5

(1) Runs 2, 5, 11 and 23 were conducted without exhaust sample.

TABLE 17C. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("O" Oily Standard)

Vehicle: Tractor 283
Date: February 3, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"O" Oily Responses 0	1	2	Average
1.	Idle		8	2	1.2
2.	Blank	3	7		0.7
3.	Const. Speed	3	7		0.7
4.	Decel	1	6	3	1.2
5.	Blank	8	2		0.2
6.	Accel	1	9		0.9
7.	Idle-Accel	2	7	1	0.9
8.	Const. Speed	5	5		0.5
9.	Idle-Accel	3	7		0.7
10.	Const. Speed	2	8		0.8
11.	Blank	9	1		0.1
12.	Accel	3	7		0.7
13.	Idle	1	8	1	1.0
14.	Const. Speed	4	5	1	0.7
15.	Idle-Accel	4	5	1	0.7
16.	Const. Speed	2	8		0.8
17.	Accel	1	8	1	1.0
18.	Idle	2	7	1	0.9
19.	Idle-Accel	1	6	3	1.2
20.	Const. Speed		8	2	1.2
21.	Decel	1	3	6	1.5
22.	Decel	1	5	4	1.3
23.	Blank	7	3		0.3
24.	Accel	1	8	1	1.0
25.	Const. Speed	3	7		0.7
26.	Const. Speed	2	8		0.8
27.	Idle		4	6	1.6
28.	Decel	2	6	2	1.0

(1) Runs 2, 5, 11 and 23 were conducted without exhaust sample.

TABLE 17D. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("A" Aromatic Standard)

Vehicle: Tractor 283
Date: February 3, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"A" Aromatic Responses 0	1	2	3	Average
1.	Idle	5	4		1	0.7
2.	Blank	9	1			0.1
3.	Const. Speed	3	7			0.7
4.	Decel	3	6		1	0.9
5.	Blank	6	4			0.4
6.	Accel	5	5			0.5
7.	Idle-Accel	3	5	2		0.9
8.	Const. Speed	5	5			0.5
9.	Idle-Accel	2	8			0.8
10.	Const. Speed	5	5			0.5
11.	Blank	9	1			0.1
12.	Accel	4	6			0.6
13.	Idle	5	4	1		0.6
14.	Const. Speed		7	3		1.3
15.	Idle-Accel	2	4	4		1.2
16.	Const. Speed	5	2	3		0.8
17.	Accel	4	5	1		0.7
18.	Idle	1	3	5	1	1.6
19.	Idle-Accel	3		6	1	1.5
20.	Const. Speed	1	5	4		1.3
21.	Decel	3	4	2	1	1.1
22.	Decel	2	5	3		1.1
23.	Blank	10				0
24.	Accel	3	5	2		0.9
25.	Const. Speed		10			1.0
26.	Const. Speed	5	3	2		0.7
27.	Idle	2	3	5		1.3
28.	Decel	1	6	3		1.2

(1) Runs 2, 5, 11 and 23 were conducted without exhaust sample.

TABLE 17E. SERIES 10 VEHICLE VARIABILITY ODOR EVALUATION RESULTS
("P" Pungent Standard)

Vehicle: Tractor 283
Date: February 3, 1967

Operating Conditions: See Table 3
Fuel: Reference No. 2

Run No. (1)	Operating Condition	"P" Pungent Responses 0	1	2	Average
1.	Idle	5	5		0.5
2.	Blank	9	1		0.1
3.	Const. Speed	6	4		0.4
4.	Decel	3	7		0.7
5.	Blank	9	1		0.1
6.	Accel	8	2		0.2
7.	Idle-Accel	8	2		0.2
8.	Const. Speed	9	1		0.1
9.	Idle-Accel	9	1		0.1
10.	Const. Speed	9	1		0.1
11.	Blank	10			0
12.	Accel	5	5		0.5
13.	Idle	1	8	1	1.0
14.	Const. Speed	7	3		0.3
15.	Idle-Accel	7	3		0.3
16.	Const. Speed	6	3	1	0.5
17.	Accel	4	5	1	0.7
18.	Idle	4	4	2	0.8
19.	Idle-Accel	3	4	3	1.0
20.	Const. Speed	3	4	3	1.0
21.	Decel		7	3	1.3
22.	Decel	3	3	4	1.1
23.	Blank	9	1		0.1
24.	Accel	4	6		0.6
25.	Const. Speed	4	6		0.6
26.	Const. Speed	6	4		0.4
27.	Idle	2	4	4	1.2
28.	Decel	2	5	3	1.1

(1) Runs 2, 5, 11 and 23 were conducted without exhaust sample.

TABLE 3. SUMMARY OF TRUCK VARIABILITY STUDY ODOR EVALUATION RESULTS

Operating Condition(1)	Odor Quality(2)	Truck-Tractor Series										Overall Average
		1	2	3	4	5	6	7	8	9	10	
I	D	3.0	2.8	3.3	1.5	3.9	2.8	3.2	2.5	2.5	3.4	2.9
II	D	3.1	2.7	2.0	2.1	2.8	2.2	1.5	1.2	2.5	3.3	2.3
III	D	4.2	3.8	4.1	4.2	3.1	3.5	3.9	2.9	4.1	4.5	3.8
IV	D	3.9	2.9	4.0	3.0	3.1	2.9	3.3	2.3	2.3	3.5	3.1
V	D	3.5	2.4	3.9	3.3	3.7	2.7	2.9	2.0	3.6	2.8	3.1
VI	D	5.4	4.2	5.3	4.7	5.9	4.9	4.6	4.0	4.6	5.5	4.9
I	B	0.7	0.8	0.8	0.3	1.1	0.7	0.7	0.4	0.5	0.5	0.7
II	B	0.6	0.7	0.4	0.6	0.6	0.6	0.3	0.3	0.5	0.9	0.5
III	B	0.9	0.9	1.0	1.1	0.9	0.9	0.9	0.7	1.0	1.1	0.9
IV	B	0.9	0.8	1.1	0.7	0.7	0.6	0.8	0.5	0.4	0.6	0.7
V	B	0.7	0.6	0.9	0.8	0.9	0.7	0.7	0.4	0.8	0.7	0.8
VI	B	1.4	1.1	1.5	1.1	1.8	1.3	1.4	1.1	1.2	1.5	1.2
I	O	0.8	0.7	0.8	0.6	0.9	0.8	0.8	0.8	0.5	0.7	0.7
II	O	0.7	0.7	0.8	0.8	0.6	0.6	0.5	0.4	0.7	0.8	0.7
III	O	0.9	0.8	0.9	1.0	0.7	1.0	0.8	0.8	1.1	1.2	1.0
IV	O	1.0	0.8	1.0	0.9	0.7	1.0	0.8	1.0	1.0	0.9	0.9
V	O	0.9	0.8	0.8	0.9	0.8	0.9	0.9	0.8	1.0	0.9	0.8
VI	O	1.1	1.0	1.3	1.1	1.3	1.1	0.9	1.0	1.2	1.5	1.2
I	A	0.7	0.6	0.9	0.4	0.8	0.7	1.0	0.8	0.5	1.0	0.7
II	A	0.8	0.5	0.5	0.6	0.7	0.6	0.2	0.3	0.3	0.8	0.5
III	A	0.9	0.9	1.0	1.0	0.6	0.8	0.8	0.8	0.8	0.8	0.8
IV	A	1.0	0.6	0.9	0.8	0.7	0.8	0.9	0.5	0.5	1.1	0.8
V	A	0.7	0.5	0.9	0.8	1.0	0.7	0.7	0.6	0.7	0.7	0.7
VI	A	1.0	0.8	1.1	1.1	1.3	1.1	0.8	0.9	0.9	0.8	1.0
I	P	0.1	0.2	0.1	0	0.4	0.1	0.1	0.4	0	0.5	0.2
II	P	0.1	0.2	0	0.1	0.2	0.1	0.1	0.1	0.2	0.4	0.2
III	P	0.4	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.6	0.9	0.4
IV	P	0.1	0.3	0.2	0.2	0.3	0	0.3	0.2	0.1	0.4	0.2
V	P	0	0.1	0.2	0.2	0.5	0.1	0.2	0.1	0.5	0.5	0.2
VI	P	0.4	0.4	0.6	0.6	1.0	0.4	0.5	0.5	0.6	1.1	0.6

(1) See Table 3 for explanation of operating conditions.

(2) "D" Diesel Composite Results
"B" Burnt-Smoky Results
"O" Oily Results
"A" Aromatic Results
"P" Pungent Results

TABLE 19. INTER-CITY TRUCK-TRACTOR VEHICLE VARIABILITY SMOKE EVALUATION CONDITIONS

Vehicle Data:	Cab-over Inter-City tandem drive truck-tractor powered by 4 cycle Cummins NH-220 naturally aspirated diesel engine via Fuller R910 Road-Ranger 10 Speed transmission and Eaton single speed rear axles. Muffler under tractor or on stack at right rear corner of cab.
Measurement Method:	U. S. Public Health Service full-flow light extinction type smokemeter mounted 5 1/2 inches above stack.
Inertia:	32, 000 lbs. vehicle weight per SwRI inertia simulation system (16, 000 lbs. vehicle weight per each of two drive axles.)

Operating Conditions

Type of Operation	Engine Speed, rpm	Vehicle Load, Hp	Drive Gear	Vehicle Speed mph (approx.)	For Details, Refer to:
A Constant Speed	1700	Open rack	7	26	Table 20
B Constant Speed	1900	Open rack	7	28	Table 20
C Constant Speed	2100	Open rack	7	32	Table 20
D Constant Speed	1700	Open rack	9	40	Table 20
E Constant Speed	1900	Open rack	9	46	Table 20
F Constant Speed	2100	Open rack	9	50	Table 20
G Idle - Acceleration	575 - 2300	Open rack (1)	1-10		Table 21

(1) With 40 hp initially impressed in water brake dynamometer at 30 mph and retained.

TABLE 20. CONSTANT SPEED DIESEL SMOKE EVALUATION PROCEDURE
(Variability Study)

Applicability:	Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through a Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.
Measurement Method:	U. S. Public Health Service full-flow light extinction type smokemeter located 5 1/2 inches above stack.
Warm-up:	A minimum of three runs should be conducted prior to smoke evaluation to assure the engine and system have reached operating temperature.
Vehicle Speeds and Loads:	Maximum vehicle smoke is to be measured at maximum power, open rack condition, in 7th and 9th gear at 1700, 1900, and 2100 rpm engine speed. Rear axles locked. 32,000 lbs. vehicle inertia simulation.
Procedure:	(1) Zero potentiometric recorder and 100% adjust smokemeter with engine "off" using 2 CFM of purge air to collimating tubes. (2) Start engine and accelerate to 7th gear and operate at 1700 rpm open rack. After measurement of smoke, release load to increase to 1900 rpm. After smoke measurement, release load and operate at 2100 rpm. (3) Upshift to 9th gear and operate at 1700 rpm open rack. After measurement of smoke, release load to increase to 1900 rpm and measure smoke. Release load for 2100 rpm open rack measure. (4) Repeat items (1) through (3) three times. Note: Each smoke measurement should be preceded by 30 seconds of stable operation.

TABLE 21. ACCELERATION DIESEL SMOKE EVALUATION PROCEDURE
(Variability Study)

Applicability:	Tandem drive axle truck-tractor powered by a Cummins NH-220 diesel engine through a Fuller 10 speed Road Ranger transmission and Eaton 1 speed rear axles.
Measurement Method:	U. S. Public Health Service full-flow light extinction type smokemeter located 5 1/2 inches above stack.
Warm-up:	A minimum of three runs should be conducted prior to smoke evaluation to assure the engine and system have reached operating temperature.
Vehicle Speed and Load:	Full rack acceleration from 5th into 6th into 7th into 8th into 9th into 10th gear under 32, 000 lbs. inertia simulation and with 40 hp total (20 hp per axle) impressed in the water brake dynamometer at 30 mph and retained.
Procedure:	(1) Zero potentiometric recorder and 100% adjust smokemeter with engine "off" using 2 CFM of purge air. (2) Start engine and allow to idle. Note maximum smoke at start on recorder and continue idle for 1 minute. (3) Accelerate to 10th gear full rack under normal type driving habit with 32, 000 lbs. inertia simulation and the initially impressed load of 40 hp at 30 mph. (4) Note the maximum smoke during each acceleration in 5th, 6th, 7th, 8th, 9th, and 10th gears. (5) Repeat steps (1) through (4) above three times.

TABLE 22. SERIES 1 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 55958
Inertia: 32, 000 lbs.

Operating Conditions: See Table 19
Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle Hp(1)	PHS Smokemeter Reading % Maximum	Minimum	Average
A - Constant	1700	7	160	22. 0	19. 0	21. 0
B - Constant	1900	7	175	22. 5	20. 5	22. 0
C - Constant	2100	7	175	22. 0	17. 5	20. 3
D - Constant	1700	9	150	23. 0	19. 0	21. 3
E - Constant	1900	9	170	22. 0	19. 0	20. 2
F - Constant	2100	9	180	20. 5	16. 0	18. 0

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, % Maximum	Minimum	Average
Engine Start	85	46	69
5th gear	20	10	13
6th gear	23	21	22
7th gear	25	21	23
8th gear	27	24	26
9th gear	26	23	25
10th gear	28	25	27

(1) Open rack, Maximum Engine Power Condition

TABLE 23. SERIES 2 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 129	Operating Conditions: See Table 19
Inertia: 32,000 lbs.	Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle Hp(1)	PHS Smokemeter Reading, % Maximum	Minimum	Average
A - Constant	1700	7	160	13.0	13.0	13.0
B - Constant	1900	7	170	17.0	16.5	17.0
C - Constant	2100	7	180	19.0	18.5	19.0
D - Constant	1700	9	160	13.0	13.0	13.0
E - Constant	1900	9	165	16.0	16.0	16.0
F - Constant	2100	9	170	18.5	17.5	18.0

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, % Maximum	Minimum	Average
Engine Start	63	44	49
5th gear	8	6	7
6th gear	11	8	10
7th gear	19	14	17
8th gear	18	16	17
9th gear	19	16	18
10th gear	14	11	13

(1) Open rack, Maximum Engine Power Condition

TABLE 24. SERIES 3 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 114
Inertia: 32, 000 lbs.

Operating Conditions: See Table 19
Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle Hp(1)	PHS Smokemeter Reading, % Maximum	Minimum	Average
A - Constant	1700	7	160	15.0	12.0	14.0
B - Constant	1900	7	170	18.0	13.0	15.0
C - Constant	2100	7	175	19.0	15.0	17.0
D - Constant	1700	9	135	16.0	12.5	14.5
E - Constant	1900	9	165	18.0	13.0	15.0
F - Constant	2100	9	150	16.0	14.5	15.0

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, % Maximum	Minimum	Average
Engine Start	55.0	37.0	43.0
5th	11	9	10
6th	18	10	16
7th	15	12	14
8th	15	12	13
9th	18	14	16
10th	30	28	29

(1) Open rack, Maximum Engine Power Condition

TABLE 25. SERIES 4 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 125
Inertia: 32, 000 lbs.

Operating Conditions: See Table 19
Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle Hp(1)	PHS Smokemeter Reading, % Maximum	Minimum	Average
A - Constant	1700	7	160	12. 5	10. 0	11. 0
B - Constant	1900	7	160	16. 0	12. 0	14. 0
C - Constant	2100	7	160	18. 0	15. 0	16. 5
D - Constant	1700	9	155	12. 0	11. 0	11. 5
E - Constant	1900	9	160	15. 5	13. 0	14. 0
F - Constant	2100	9	155	18. 5	17. 0	17. 5

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, % Maximum	Minimum	Average
Engine Start	32	30	31
5th	13	11	12
6th	21	15	18
7th	22	16	18
8th	18	14	16
9th	13	10	12
10th	21	14	17

(1) Open rack, Maximum Engine Power Condition

TABLE 26. SERIES 5 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 135
Inertia: 32,000 lbs.

Operating Conditions: See Table 19
Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle Hp(1)	PHS Smokemeter Reading, % Maximum	Minimum	Average
A - Constant	1700	7	160	32.0	30.0	31.0
B - Constant	1900	7	170	34.0	32.0	33.0
C - Constant	2100	7	185	35.0	33.0	34.0
D - Constant	1700	9	145	33.0	32.0	32.5
E - Constant	1900	9	160	33.0	31.5	32.0
F - Constant	2100	9	170	34.0	34.0	34.0

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, % Maximum	Minimum	Average
Engine Start	30	25	27
5th	37	26	33
6th	40	28	37
7th	40	31	40
8th	48	41	45
9th	37	35	36
10th	37	32	35

(1) Open rack, Maximum Engine Power Condition

TABLE 27. SERIES 6 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 282
Inertia: 32, 000 lbs.

Operating Conditions: See Table 19
Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle Hp(1)	PHS Smokemeter Reading, %		
				Maximum	Minimum	Average
A - Constant	1700	7	160	22.0	20.0	21.0
B - Constant	1900	7	170	25.0	23.0	24.0
C - Constant	2100	7	170	26.0	23.0	25.0
D - Constant	1700	9	140	26.0	22.0	24.0
E - Constant	1900	9	145	25.0	22.0	24.0
F - Constant	2100	9	130	23.0	23.0	23.0

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, %		
	Maximum	Minimum	Average
Engine Start	52	25	39
5th	27	23	25
6th	27	24	26
7th	28	25	27
8th	29	26	28
9th	31	26	28
10th	32	29	31

(1) Open rack, Maximum Engine Power Condition

TABLE 28. SERIES 7 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 286	Operating Conditions: See Table 19
Inertia: 32,000 lbs.	Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle Hp[1]	PHS Smokemeter Reading, % Maximum	Minimum	Average
A - Constant	1700	7	160	18.0	17.0	17.5
B - Constant	1900	7	160	18.0	16.0	17.0
C - Constant	2100	7	160	18.0	18.0	18.0
D - Constant	1700	9	140	18.0	15.0	17.0
E - Constant	1900	9	140	18.0	16.0	17.0
F - Constant	2100	9	140	18.0	17.5	18.0

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, % Maximum	Minimum	Average
Engine Start	55	45	51
5th	21.0	20.0	21.0
6th	21.0	17.0	19.0
7th	21.0	17.0	19.0
8th	18.5	17.0	18.0
9th	23.0	20.0	22.0
10th	25.0	23.0	24.0

(1) Open rack, Maximum Engine Power Condition

TABLE 29. SERIES 8 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 284
Inertia: 32, 000 lbs.

Operating Conditions: See Table 19
Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle Hp[1]	PHS Smokemeter Reading, % Maximum	Minimum	Average
A - Constant	1700	7	160	29.0	27.0	28.0
B - Constant	1900	7	160	29.0	27.0	28.0
C - Constant	2100	7	160	30.0	28.0	29.0
D - Constant	1700	9	140	27.0	25.0	26.0
E - Constant	1900	9	140	26.5	26.5	26.5
F - Constant	2100	9	140	28.0	27.0	27.0

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, % Maximum	Minimum	Average
Engine Start	66	57	61
5th	37	34	35
6th	33	32	32
7th	31	30	30
8th	31	30	31
9th	28	24	27
10th	44	27	32

(1) Open rack, Maximum Engine Power Condition

TABLE 30. SERIES 9 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 285
Inertia: 32, 000 lbs.

Operating Conditions: See Table 19
Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle Hp(1)	PHS Smokemeter Reading, %		
				Maximum	Minimum	Average
A - Constant	1700	7	160	20. 0	18. 0	19. 0
B - Constant	1900	7	160	22. 0	20. 0	21. 0
C - Constant	2100	7	160	25. 0	22. 0	23. 5
D - Constant	1700	9	140	22. 0	18. 0	21. 0
E - Constant	1900	9	140	21. 0	19. 0	20. 0
F - Constant	2100	9	140	23. 0	22. 0	23. 0

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, %		
	Maximum	Minimum	Average
Engine Start	53	44	47
5th	23	14	20
6th	20	19	20
7th	21	18	19
8th	21	19	20
9th	18	17	17
10th	23	21	22

(1) Open rack, Maximum Engine Power Condition

TABLE 31. SERIES 10 VEHICLE VARIABILITY SMOKE EVALUATION SUMMARY

Vehicle: Tractor 283
Inertia: 32,000 lbs.

Operating Conditions: See Table 19
Fuel: Reference No. 2

Constant Speed Results

Type of Operation	Engine Speed, rpm	Gear No.	Vehicle $Hp^{(1)}$	PHS Smokemeter Reading, %		
				Maximum	Minimum	Average
A - Constant	1700	7	160	18.0	15.0	16.0
B - Constant	1900	7	160	17.0	17.0	17.0
C - Constant	2100	7	160	19.0	18.0	19.0
D - Constant	1700	9	140	18.0	15.0	16.0
E - Constant	1900	9	140	17.0	16.0	16.5
F - Constant	2100	9	140	20.0	19.0	20.0

G - Transient

Acceleration Results

Drive Gear	PHS Smokemeter Reading, %		
	Maximum	Minimum	Average
Engine Start	62	46	54
5th	20	15	17
6th	16	14	15
7th	15	13	14
8th	16	13	15
9th	16	13	15
10th	19	18	18

(1) Open rack, Maximum Engine Power Condition

TABLE 4. SUMMARY OF TRUCK VARIABILITY STUDY SMOKE EVALUATION RESULTS

Type of Operation[1]	Gear No.	Engine Speed, rpm	Truck-Tractor Series										Overall Average
			1	2	3	4	5	6	7	8	9	10	
A - Constant Speed	7	1700	21.0	13.0	14.0	11.0	31.0	21.0	17.5	28.0	19.0	16.0	19.2
B - Constant Speed	7	1900	22.0	17.0	15.0	14.0	33.0	24.0	17.0	28.0	21.0	17.0	20.8
C - Constant Speed	7	2100	20.3	19.0	17.0	16.5	34.0	25.0	18.0	29.0	23.5	19.0	22.0
D - Constant Speed	9	1700	21.3	13.0	14.5	11.5	32.5	24.0	17.0	26.0	21.0	16.0	19.7
E - Constant Speed	9	1900	20.2	16.0	15.0	14.0	32.0	24.0	17.0	26.5	20.0	16.5	20.1
F - Constant Speed	9	2100	18.0	18.0	15.0	17.5	34.0	23.0	18.0	27.0	23.0	20.0	21.4
G - Acceleration (40 hp @ 30 mph)	N	Start	69.0	49.0	43.0	31.0	27.0	39.0	51.0	61.0	47.0	54.0	46.9
	5	-	13.0	7.0	10.0	12.0	33.0	25.0	21.0	35.0	20.0	17.0	19.3
	6	-	22.0	10.0	16.0	18.0	37.0	26.0	19.0	32.0	20.0	15.0	21.5
	7	-	23.0	17.0	14.0	18.0	40.0	27.0	19.0	30.0	19.0	14.0	22.1
	8	-	26.0	17.0	13.0	16.0	45.0	28.0	18.0	31.0	20.0	15.0	22.9
	9	-	25.0	18.0	16.0	12.0	36.0	28.0	22.0	27.0	17.0	15.0	21.6
	10	-	27.0	13.0	29.0	17.0	35.0	31.0	24.0	32.0	22.0	18.0	24.8

[1] All constant speed smoke measurements made at maximum power output.

All idle-acceleration smoke measurements made at open rack with 32,000 lbs. inertia simulation.

TABLE 33. MAINTENANCE SUMMARY OF INTER-CITY TRUCK-TRACTORS EVALUATED

(Variability Study)

The following listed truck-tractors were evaluated during the ten-vehicle variability study. Only pertinent engine maintenance is indicated. All truck-tractors were tandem axle cab-over type and powered by similar Cummins NH-220 naturally aspirated four cycle 6 cylinder engine with PT type fuel pump. The drive train consisted of model R-910 Fuller Road Ranger ten forward speed transmission and single speed Eaton tandem rear axles.

Test Series No.	Truck No. (Source)	Tractor Mfg.	Type Service	Tractor Mileage: Date of Test	Tractor Mileage: Last Injector Adjustment	Miles Since Last Injector Check & Tune up
1	55958 (Ryder)	Ford H-950D	Rental Fleet	75, 952	49, 965	25, 987
2	129 (ABC)	White Freightliner	General Freight	55, 811	49, 609	6, 202
3	114 (ABC)	White Freightliner	Rental Fleet	179, 365	154, 472(1)	24, 893
4	125 (ABC)	White Freightliner	Steel Products	87, 770	78, 353(2)	9, 417
5	135 (ABC)	White Freightliner	Rental Fleet	87, 760	62, 164	25, 596
6	282 (Howell)	International Harvester	Petroleum Products	372, 827	365, 814(3)	7, 013
7	286 (Howell)	International Harvester	Petroleum Products	159, 465	134,520	24, 945
8	284 (Howell)	International Harvester	Petroleum Products	303, 501	258, 730	44, 771
9	285 (Howell)	International Harvester	Petroleum Products	343, 579	297, 659	45, 920
10	283 (Howell)	International Harvester	Petroleum Products	353, 210	344, 943	8, 267

(1) Major engine overhaul performed at 119, 000 miles (including rings, valves, bearings, etc.)

(2) Major engine overhaul performed at 78, 353 miles (including rings, valves, bearings, etc.)

(3) Major engine overhaul performed at 207, 944 miles (including rings, valves, bearings, etc.)

APPENDIX G

PHASE F FUMIGATION RESULTS
(Cummins NH 220, Four-Cycle Diesel Engine)

TABLE 1. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(All Open Rack Engine Operation)

Fumigation Method: Pneumatic Spray Atomization in Can

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 64° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: 10.3 Lbs/Hr

Engine Speed, rpm	Power Out, hp	Fuel Cons. Lbs/Hr (1)	Fum. Rate, %	Fum. On/Off	Smoke Read. %	% Smoke Increase
1700	167	66.8		Off	10	
	177		15.4	On	18	80
Power Increase 10						
1700	172	68.8		Off	12	
	180		14.9	On	18	50
Power Increase 8						
1900	184	73.6		Off	11	
	198		14.0	On	17	55
Power Increase 14						
1900	184	73.6		Off	10	
	198		14.0	On	16	60
Power Increase 14						
2100	189	75.6		Off	11	
	204		13.6	On	14	27
Power Increase 15						
2100	189	75.6		Off	10	
	206		13.6	On	13.5	35
Power Increase 17						

(1) Based on 0.4 Lbs/BHP-Hr Specific Fuel Consumption

TABLE 2. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(At Equivalent Power Outputs)

Fumigation Method: Pneumatic Spray Atomization in Can

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 58° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: 10.3 Lbs/Hr

Engine Speed, rpm	Power Out, hp	Fuel Cons. lbs/hr (1)	Fum. Rate, %	Rack Position	Fum. On/Off	Smoke Read. %	% Smoke Improve.
1700	167	66.8		Open	Off	9	
	167		15.4	Part	On	9.5	5
1700	167	66.8		Open	Off	10	
	167		15.4	Part	On	8.5	15
1700	172	68.8		Open	Off	7.5	
	172		14.9	Part	On	8.5	13
1700	172	68.8		Open	Off	7.5	
	172		14.9	Part	On	8.5	13
1900	184	73.6		Open	Off	7.5	
	184		14.0	Part	On	7	7
1900	184	73.6		Open	Off	7.5	
	184		14.0	Part	On	7	7
2100	192	76.8		Open	Off	9	
	192		13.5	Part	On	10	11
2100	194	77.6		Open	Off	9	
	194		13.3	Part	On	10	11

(1) Based on 0.4 Lbs/BHP-Hr Specific Fuel Consumption

TABLE 3. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(All Open Rack Operation)

Fumigation Method: Pneumatic Spray Atomization in Can

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 52° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: 9.5 Lbs/Hr

Engine Speed, rpm	Power Out, hp	Fuel Cons. Lbs/Hr (1)	Fum. Rate, %	Fum. On/Off	Smoke Read. %	% Smoke Increase
1700	167	66.8		Off	7	
	181		14.2	On	13	85
Power Increase 14						
1700	172	68.8		Off	7	
	181		13.8	On	12	71
Power Increase 9						
1900	184	73.6		Off	9	
	194		12.9	On	11	22
Power Increase 10						
1900	184	73.6		Off	8	
	199		12.9	On	11	37
Power Increase 15						
2100	188	75.2		Off	9	
	205		12.6	On	13	44
Power Increase 17						
2100	194	77.6		Off	9	
	207		12.2	On	13	44
Power Increase 13						

(1) Based on 0.4 Lbs/BHP-Hr Specific Fuel Consumption

TABLE 4. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(At Equivalent Power Outputs)

Fumigation Method: Pneumatic Spray Atomization in Can

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 46° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: 9.5 Lbs/Hr

Engine Speed, rpm	Power Out, hp	Fuel Cons. lbs/hr (1)	Fum. Rate, %	Rack Position	Fum. On/Off	Smoke Read. %	% Smoke Improve.
1700	167	66.8		Open	Off	9	
	167		14.2	Part	On	9	-
1700	167	66.8		Open	Off	10	
	167		14.2	Part	On	9	10
1900	184	73.6		Open	Off	9	
	184		12.9	Part	On	10	12
1900	184	73.6		Open	Off	10	
	184		12.9	Part	On	9	10
2100	188	75.2		Open	Off	13	
	188		12.6	Part	On	13	-
2100	188	75.2		Open	Off	11	
	188		12.6	Part	On	11	-

(1) Based on 0.4 Lbs/BHP-Hr Specific Fuel Consumption

TABLE 5. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(Injectors Back Pressured)

Fumigation Method: Pneumatic Spray Atomization in Can

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 48° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: 9.5 Lbs/Hr

Engine Speed, rpm	Power Out, hp	Fuel Cons. lbs/hr (1)	Fum. Rate, %	Back Pressure	Rack Position	Fum. On/Off	Smoke Read. %
1700	167	66.8		0	Open	Off	9
	198	79.2		40	Open	Off	34
	198		12.0	40	Part	On	26
			Percent Smoke Improvement				24
1700	167	66.8		0	Open	Off	9
	199	79.6		40	Open	Off	29
	199		12.0	40	Part	On	21
			Percent Smoke Improvement				27
1900	187	74.8		0	Open	Off	11
	222	88.8		40	Open	Off	29
	222		10.7	40	Part	On	19
			Percent Smoke Improvement				34
2100	196	78.4		0	Open	Off	9
	237	94.8		50	Open	Off	17
	237		10.2	50	Part	On	14
			Percent Smoke Improvement				2

(1) Based on 0.4 Lbs/BHP-Hr Specific Fuel Consumption

TABLE 6. EFFECT OF FUMIGATION ON EXHAUST SMOKE

Fumigation Method: Pneumatic Spray Atomization in Can

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 36° F

Injected Fuel: Reference No. 2
Fumigant: Reference No. 2
Fumigant Rate: 9.5 Lbs/Hr

Engine Speed, rpm	Power Out, hp	Fuel Cons. lbs/hr (1)	Fum. Rate, %	Rack Position	Fum. On/Off	Smoke Read. %	% Smoke Improve.
1700	193	84		Open	Off	35	
	193		11.3	Part	On	25	29
	193	84		Open	Off	35	
	193		11.3	Part	On	26	26
	193	84		Open	Off	36	
	193		11.3	Part	On	27	25
1900	222	91.6		Open	Off	34	
	222		10.4	Part	On	26	24
	217	90.5		Open	Off	35	
	217		10.5	Part	On	29	17
	222	91.6		Open	Off	34	
	222		10.4	Part	On	30	12
2100	237	94.0		Open	Off	26	
	237		10.2	Part	On	24	8
	237	94.0		Open	Off	26	
	237		10.2	Part	On	24	8
	236	93.5		Open	Off	25	
	236		10.3	Part	On	24	4

(1) Measured Fuel Consumption

TABLE 7. EFFECT OF FUMIGATION RATE ON EXHAUST SMOKE
(At Equivalent Power Output)

Fumigation Method: Pneumatic Spray Atomization in Can

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 58° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: See Below

Engine Speed, rpm	Power Out, hp	Fuel Cons. lbs/hr (1)	Fum. Rate lbs/hr	Fum. Rate, %	Smoke Read. %	% Smoke Improve.
1700	192	84.0	0	-	32	-
1700	192		5.7	6.8	28	12
1700	192		7.4	8.8	25	22
1700	192		9.65	11.4	22	31
1700	192		13.8	16.4	24	25
1700	192		16.8	20.0	26	19
1700	192		19.7	23.5	30	7
1900	213	89.6	0	-	28	-
1900	213		5.7	6.4	27	3
1900	213		7.4	8.3	26	7
1900	213		9.65	10.8	24	14
1900	213		13.8	15.4	25	11
1900	213		16.8	18.7	27	3
1900	213		19.7	22.0	31	11

(1) Measured Fuel Consumption

TABLE 8. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(At Equivalent Power Output)

Fumigation Method: Continuous High Pressure Spray in Can

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 55° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: 7.0 Lbs/Hr

Engine Speed, rpm	Power Out, hp	Fuel Cons. lbs/hr (1)	Fum. Rate, %	Rack Position	Fum. On/Off	Smoke Read. %	% Smoke Improve.
1700	194	84.8		Open	Off	30	
	194		8.3	Part	On	24	20
1700	197	85.5		Open	Off	30	
	197		8.2	Part	On	25	17
1900	222	91.6		Open	Off	28	
	222		7.7	Part	On	24	14
1900	217	91.4		Open	Off	26	
	217		7.7	Part	On	22	15
2100	230	91.1		Open	Off	22	
	230		7.7	Part	On	20	9
2100	230	91.1		Open	Off	21	
	230		7.7	Part	On	19	9

(1) Measured Fuel Consumption

TABLE 9. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(At Equivalent Power Output)

Fumigation Method: Continuous High Pressure Spray in Can

Engine: Cummins NH-220	Injected Fuel: Reference No. 2
Coolant Out: 180° F	Fumigated Fuel: Reference No. 2
Ambient: 47° F	Fumigant Rate: 10 Lbs/Hr

Engine Speed, rpm	Power Out, hp	Fuel Cons. lbs/hr	Fum. Rate, %	Rack Position	Fum. On/Off	Smoke Read. %	% Smoke Improve.
1700	195	84.8		Open	Off	36	
	195		11.8	Part	On	27	25
1700	199	85.2		Open	Off	36	
	199		11.7	Part	On	29	19
1900	222	91.6		Open	Off	32	
	222		10.9	Part	On	24	25
1900	222	91.6		Open	Off	30	
	222		10.9	Part	On	22	26
2100	237	93.5		Open	Off	23	
	237		10.7	Part	On	21	9
2100	235	93.0		Open	Off	23	
	235		10.8	Part	On	21	9

TABLE 10. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(At Equivalent Power Output)

Fumigation Method: Continuous High Pressure Spray in Can

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 49° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: 13.6 Lbs/Hr

Engine Speed, rpm	Power Out, hp	Fuel Cons. lbs/hr	Fum. Rate, %	Rack Position	Fum. On/Off	Smoke Read. %	% Smoke Improve.
1700	199	85.2		Open	Off	34	
	199		16	Part	On	30	12
1700	198	85.0		Open	Off	36	
	198		16	Part	On	31	14
1900	222	91.6		Open	Off	32	
	222		14.8	Part	On	28	12
1900	222	91.6		Open	Off	32	
	222		14.8	Part	On	29	9
2100	235	93.0		Open	Off	26	
	235		14.6	Part	On	26	0
2100	237	93.5		Open	Off	26	
	237		14.6	Part	On	26	0

TABLE 11. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(At Equivalent Power Output)

Fumigation Method: Pneumatic Spray Atomization in Intake Manifold

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 56° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: See Below

Engine Speed, rpm	Power Out, Hp	Fuel Cons. lbs/hr (1)	Fum. Rate lbs/hr	Fum. Rate, %	Smoke Read, %	% Smoke Improve.
900	91	40.5	0	--	42	--
			0.6	0.7	10	76
			1.8	4.5	9	79
			4.5	11.1	8	80
			10.7	26.5	9	79
Combustion Noise			18.8	46.5	25	40
1100	115	52	0	--	50	--
			1.8	3.5	18	64
			4.8	9.3	13	74
			11.0	21.1	12	76
Combustion Noise			20.0	38.5	24	52
1300	142	64	0	--	42	--
			1.9	3.0	20	52
			4.7	7.3	18	57
			11.5	17.9	19	55
			18.3	28.5	36	14
1500	165	75	0	--	28	--
			1.8	2.4	22	21
			4.6	6.1	21	25
			11.0	14.6	20	29
			19.0	25.3	27	4

(1) Measured fuel consumption.

Table 11 (Continued)

Engine Speed, rpm	Power Out, Hp	Fuel Cons. lbs/hr (1)	Fum. Rate lbs/hr	Fum. Rate, %	Smoke Read, %	% Smoke Improve.
1700	192	84.8	0	--	34	--
			0.5	0.6	25	26
			1.1	1.6	24	29
			1.9	2.2	25	26
			3.1	3.7	24	29
			4.9	5.8	24	29
			11.1	13.1	24	29
			15.8	18.6	27	26
			18.8	22.2	29	15
1900	208	88.2	0	--	24	--
			1.8	2.0	20	20
			4.7	5.3	20	20
			11.1	12.6	20	20
			18.8	21.3	25	(4)
2100	220	91.0	0	--	20	--
			1.8	2.0	18	10
			5.2	5.7	18	10
			12.1	13.3	19	5
			18.8	20.6	22	(10)
2250	225	92.0	0	--	18	--
			1.8	2.0	18	0
			4.9	5.3	18	0
			11.2	12.2	18	0
			22.4	24.4	20	(11)

( ) denotes smoke increase

TABLE 12. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(At Equivalent Power Output)

Fumigation Method: Continuous High Pressure Spray in Intake Manifold

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 54° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigated Rate: Approx. 2.5 lbs/hr

Engine Speed, rpm	Power Out, Hp	Fuel Cons. lbs/hr(1)	Fum. Rate lbs/hr	Fum. Rate, %	Smoke Read, %	% Smoke Improve.
900	98	45.0	0	--	38	--
			2.4	5.3	13	66
1100	120	54.0	0	--	57	--
			2.3	4.3	22	44
1300	147	66.0	0	--	48	--
			2.2	3.3	24	50
1500	168	71.2	0	--	37	--
			2.5	3.5	28	24
1700	193	84.2	0	--	36	--
			2.4	2.9	27	25
1900	213	89.5	0	--	32	--
			2.4	2.7	26	19
2100	226	92.0	0	--	26	--
			2.2	2.4	25	4
2250	233	93.0	0	--	24	--
			2.4	2.6	24	0

(1) Measured fuel consumption

TABLE 13. EFFECT OF FUMIGATION ON EXHAUST SMOKE
(At Equivalent Power Output)

Fumigation Method: Continuous High Pressure Spray in Intake Manifold

Engine: Cummins NH-220
Coolant Out: 180°F
Ambient: 61°F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: Approx. 6 lbs/hr

Engine Speed, rpm	Power Out, Hp	Fuel Cons. lbs/hr(1)	Fum. Rate lbs/hr	Fum. Rate, %	Smoke Read., %	% Smoke Improve.
900	98	45.0	0	--	48	--
			5.9	13.2	11	77
1100	118	53.8	0	--	58	--
			5.8	10.7	17	70
1300	147	66.0	0	--	48	--
			6.1	9.2	40	20
1500	168	71.2	0	--	33	--
			6.0	8.4	29	12
1700	192	84.0	0	--	33	--
			6.0	7.2	28	15
1900	213	89.5	0	--	32	--
			5.7	6.4	28	13
2100	227	92.1	0	--	26	--
			5.6	6.1	24	8
2250	233	93.6	0	--	25	--
			5.7	6.0	25	0

(1) Measured fuel consumption

TABLE 14. EFFECT OF FUMIGATION ON EXHAUST SMOKE

(At Equivalent Power Output)

Fumigation Method: Continuous High Pressure Spray in Intake Manifold

Engine: Cummins NH-220
Coolant Out: 180°F
Ambient: 65° F

Injected Fuel: Reference No. 2
Fumigated Fuel: Reference No. 2
Fumigant Rate: Approx. 10 lbs/hr

Engine Speed, rpm	Power Out, Hp	Fuel Cons. lbs/hr (1)	Fum. Rate lbs/hr	Fum. Rate, %	Smoke Read., %	% Smoke Improve.
900	98	45.0	0	--	45	--
	Combustion Noise		9.8	21.8	23	49
1100	118	53.8	0	--	57	--
	Combustion Noise		9.8	18.2	24	58
1300	146	65.7	0	--	48	--
			10.1	15.4	26	46
1500	168	71.2	0	--	34	--
			10.1	14.2	26	24
1700	193	84.2	0	--	33	--
			10.1	12.0	28	18
1900	213	89.5	0	--	29	--
			9.4	10.5	24	17
2100	226	92.0	0	--	26	--
			9.6	10.4	25	4
2250	233	93.0	0	--	24	--
			9.8	10.5	24	0

(1) Measured fuel consumption

APPENDIX H

EXHAUST DILUTION RESULTS WITH CUMMINS NH 220 ENGINE

TABLE 1. EFFECT OF EXHAUST DILUTION ON EXHAUST SMOKE
(All Open Rack-Maximum Power)

Dilution Method: Air Injection in Exhaust Manifold
At Underside of Outer Exhaust Valve

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 52°F

Injected Fuel: Reference No. 2
Air Source: Laboratory System

Engine Speed rpm	Power Out, Hp	Exhaust Flow, CFM	Dilution Flow, CFM	Percent Dilution	Smoke Read. %	% Smoke Improve.
1500	163	275	0	--	28	--
			15.7	6	21	25
			21.1	8	20	29
1700	192	315	0	--	32	--
			6.1	2	27	16
			9.7	3	25	22
			12.7	4	22	31
			15.7	5	26	19
			18.3	6	23	28
			21.1	7	24	25
1900	213	355	0	--	31	--
			15.7	4	25	19
			21.1	6	23	25
2100	223	395	0	--	23	--
			15.7	4	22	5
			21.1	5	22	5

TABLE 2. EFFECT OF EXHAUST DILUTION ON EXHAUST SMOKE

(All Open Rack-Maximum Power)

Dilution Method: Air Injection in Exhaust Manifold
At Underside of Outer Exhaust Valve with Preheated
Air

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 65° F

Injected Fuel: Reference No. 2
Air Source: Laboratory System
Preheat Source: Exhaust Stack

Engine Speed, rpm	Power Out, Hp	Exhaust Flow, CFM	Dilution Flow, CFM	Percent Dilution	Smoke Read. %	% Smoke Improve.
900	93	165	0	--	38	--
			6.1	4	38	0
			9.7	6	36	5
			12.7	8	35	8
			15.7	10	35	8
			18.3	11	35	8
			21.1	13	35	8
1100	115	195	0	--	51	--
			6.1	3	49	4
			9.7	5	47	8
			12.7	6	45	12
			15.7	8	45	12
			18.3	9	45	12
			21.1	11	45	12
1300	141	240	0	--	39	--
			6.1	3	37	5
			9.7	4	39	0
			12.7	5	38	3
			15.7	7	38	3
			18.3	8	36	8
			21.1	9	35	10

Table 2 (Continued)

Engine Speed, rpm	Power Out, Hp	Exhaust Flow, CFM	Dilution Flow, CFM	Percent Dilution	Smoke Read. %	% Smoke Improve.
1500	165	275	0	--	30	--
			6.1	2	27	10
			9.7	4	27	10
			12.7	5	27	10
			15.7	6	25	17
			18.3	7	25	17
			21.1	8	24	20
1700	186	315	0	--	30	--
			6.1	2	28	7
			9.7	3	26	13
			12.7	4	24	20
			15.7	5	24	20
			18.3	6	23	23
			21.1	7	23	23
1900	207	355	0	--	27	--
			6.1	2	27	0
			9.7	3	26	4
			12.7	4	25	7
			15.7	5	25	7
			18.3	6	24	11
			21.1	7	24	11
2100	220	395	0	--	23	--
			6.1	2	23	0
			9.7	2	22	4
			12.7	3	20	13
			15.7	4	19	17
			18.3	5	20	13
			21.1	6	19	17
2250	223	415	0	--	23	--
			6.1	1	21	9
			9.7	2	20	13
			12.7	3	20	13
			15.7	4	20	13
			18.3	5	20	13
			21.1	6	20	13

TABLE 3. EFFECT OF EXHAUST DILUTION ON EXHAUST SMOKE

(All Open Rack-Maximum Power)

Dilution Method: Air Added to Exhaust Between
Exhaust Manifold Outlet and Muffler Inlet

Engine: Cummins NH-220
Coolant Out: 180° F
Ambient: 54° F

Injected Fuel: Reference No. 2
Air Source: Pressure Blower System

Engine Speed, rpm	Power Out, Hp	Exhaust Flow, CFM	Dilution Flow, CFM	Percent Dilution	Smoke Read. %	% Smoke Improve.
900	93	165	0	--	35	--
			50	30	35	0
			100	60	35	0
			150	90	35	0
			200	120	32	9
			250	150	32	9
			300	180	28	20
			335	200	26	20
1100	116	195	0	--	53	--
			50	25	50	6
			100	50	48	9
			150	75	44	17
			200	100	46	14
			250	125	44	17
			270	140	45	15
1300	142	240	0	--	48	--
			50	20	41	14
			100	40	39	19
			150	60	40	16
			200	80	38	20
			210	87	38	20
1500	162	275	0	--	31	--
			50	18	28	9
			100	36	30	3
			150	54	30	3
			190	70	30	3

Table 3 (Continued)

Engine Speed, rpm	Power Out, Hp	Exhaust Flow, CFM	Dilution Flow, CFM	Percent Dilution	Smoke Read. %	%Smoke Improve
1700	187	315	0	--	33	--
			50	16	31	7
			100	32	29	12
			150	48	28	15
			165	52	27	18
1900	208	355	0	--	31	--
			50	14	29	6
			100	28	30	3
			150	42	30	3
			170	48	28	11
2100	220	395	0	--	24	--
			50	12	24	0
			100	24	23	4
			150	36	22	8
			160	40	22	8
2250	227	415	0	--	24	--
			50	12	22	8
			100	24	24	0
			150	36	23	4
			200	48	23	4